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ALEXANDER BIRD

Nature's Metaphysics

Laws and Properties

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by
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For Janie and David Fowell

PREFACE

While writing my first book, on the philosophy of science, I wondered what a world would be like without any laws of nature. Considering first David Armstrong's view of laws, this is easy to imagine. Laws are higher-order relations among properties. So those higher-order relations would go. But particulars would still have their properties and relations, just as they did with the laws. It is more difficult to imagine a world without David Lewis's laws, since these are just regularities of a systematic kind. One could remove some of the actual laws by introducing some more facts, ones inconsistent with the law–regularities; but even then there will be some way of systematizing all the facts, even if very untidily. Nevertheless, the idea of changing and removing laws is still consistent with particulars retaining the properties they have. And in any case, as Stephen Mumford explains, Lewis's picture is one without laws at all if you have any robust expectations of laws. So for both Armstrong and Lewis the possession of specific properties by things is entirely consistent with there being no laws that govern those properties. But what then differentiates the properties from one another? Such a world is allegedly full of things with different properties, but no thing is causing any other thing to happen. The electron's negative charge and the positron's positive charge are said to differ, but without laws concerning charge the two kinds of particle do not differ in their behaviour. Such a world seemed to me hardly to be a genuine possibility. But at the time, the accounts of law provided by Lewis and Armstrong were the two principle contenders in the field. There was something wrong with both, in the divorce between what properties are and what properties do. The behaviour, or rather the tendency towards certain patterns of behaviour should be built into the properties—or so it struck me. If that is the case, then we do not need laws as external rules telling properties how to interact; the laws would also be built into the properties. At the time I was thinking about such things, circa 1997–8, I was independently beginning to write about dispositions, stimulated first by Lewis's 'Finkish Dispositions' and then by Mumford's *Dispositions*. Even if properties are what they do, a propertied entity does not have to be doing things at all times; it has merely to be capable of doing them. So the intimate link between laws and properties suggests that properties should be considered as dispositions.[1]

Such thoughts were far from original. The idea that properties have their identities fixed by their causal roles originates with Sydney Shoemaker. The proposal that this accounts for the laws of nature is put forward by Chris Swoyer and developed by Simon Bostock and Max Kistler. A metaphysics with these ideas as central

[1] That laws could be considered as reflections of dispositions is proposed by Mumford. But that idea struck me as being at odds with his other claim that the dispositional/categorical distinction is a distinction between predicates. Surely laws could not rest on such a metaphysically flimsy foundation. Subsequently Mumford has developed a more substantial metaphysics of dispositional properties, one which he thinks obviates the need for laws at all.

components, in particular the thought that properties have dispositional essences—*dispositional essentialism* as it has become known—is promoted by Brian Ellis. And most recently Mumford argues at length for a similar metaphysics but without laws at all. Not being the first to publish an idea sometimes has its advantages. In this case I have had the opportunity first to reflect on the strengths and weaknesses of my predecessors' views and secondly, and more importantly, to work at length on the details of a view that is to a greater or lesser degree shared by all those mentioned in this paragraph. It is said that the devil is in the details, but also that God is in the details.[2] Both are true. Whether a philosophical or scientific theory stands or falls will depend on how the leading ideas are articulated in detail. I hope to show that there is more God than devil in the details of dispositional essentialism.

This book is the result of work carried out over nine years, much of which has been published as individual papers, which were presented in earlier incarnations to numerous audiences. So it is difficult to estimate the number of people who have influenced its outcome, let alone to register them all. I hope that those audiences may nonetheless recognize passages that they have heard and know that I am grateful to them for their contribution. However a particularly important group deserves special mention, at whose meetings a large proportion of this book has been presented. The Metaphysics of Science group first gathered at a meeting organized by Johannes Persson in Lund in early 2002. We met later that year in Edinburgh, at a time when I was still at Edinburgh University. And on the strength of those early workshops, Helen Beebee gained British Academy funding for an International Network which allowed the group to continue its workshops, first in Athens, in 2003, organized by Stathis Psillos. The next meeting was in Reading, 2004, coinciding with the *Ratio* Metaphysics in Science conference, both organized by Alice Drewery. Subsequently we met in Ghent, in 2005, organized by Rob Vanderbeeken and Erik Weber, and in Birmingham, in 2006, organized by Helen Beebee. In addition to those mentioned, the group's membership includes Anna-Sofia Maurin, James Ladyman, Annika Wallin, Paul Noordhof, Rebecca Schweder, Katherine Hawley, Joanna Odrowaz-Sypniewska, Samir Okasha, Emma Tobin (who also read the whole of the penultimate draft), and Stephen Mumford; to these I am especially grateful, as I am also to quondam members of the group, including Brian Ellis, Sungho Choi, Michael Esfeld, Fraser MacBride, Daniel Nolan, Chris Daly, Toby Handfield, Stephen Barker, and Peter Clark. In addition to several of those already mentioned, the following have also kindly commented on various parts of the book in draft: David Armstrong, Anthony Everett, Jan Hauska, Leon Horsten, Richard Holton, Jon Jacobs, Rae Langton, Amir Karbasizadeh, Hugh Mellor, Finn Spicer, and Tim Williamson. I would also like to remember David Lewis in gratitude for his correspondence with me concerning dispositions.

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[2] The latter is attributed to Mies van der Rohe, but also to Gustave Flaubert. The former may be a variant.

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1

INTRODUCTION—LAWS AND PROPERTIES

1.1 Laws of nature and natural properties

This book is about the metaphysics of laws of nature and of natural properties. These are clearly connected, since laws concern the properties of things. Thus the law of gravity tells us how the force on an object depends on its mass and the mass of other objects as well as their separations; Kirchhoff's laws tell us how the current, electromotive force, and impedance in electrical circuits are related, where those quantities are properties of the circuit or its parts; the laws of thermodynamics relate the thermal properties, such as heat, entropy, and temperature of substances and systems. Two influential views concerning laws agree that laws concern properties but regard the connection as loose. They both regard the laws of nature as metaphysically contingent—the laws could have been otherwise. So the masses and separations of objects need not have been related to the forces on them in the way that the law of gravitation says; indeed they need not have been related by any law at all. A third view concerning laws says that the connection is rather tighter. The properties of things can only relate in laws as they actually relate—it is metaphysically necessary that they do so. It is part of the very nature or essence of those properties that they relate as they do. It is this third view that I promote and defend in this book.

The two views advocating a loose connection are the regularity theory of laws and the nomic necessitation view. The first finds its most advanced articulation in the work of David Lewis (1973), developed from earlier proposals due to Mill and Ramsey, while the second is promoted by David Armstrong (1983), Michael Tooley (1977), and Fred Dretske (1977). According to Lewis's regularity theory, ultimately all there is in the world are individual things possessing the properties (among which I include relations) that they do. Laws are not anything extra in addition to the things possessing their properties. Rather the laws are just certain regular patterns of things possessing properties. A little more precisely, laws are regularities that fit into or may be derived from the optimal systematization of the facts concerning individual things. I see this as a metaphysically *thin* picture of laws. While it may give a pleasingly simple and demystifying picture of laws, its thinness means, I shall argue, that were it correct, laws would be unable to do anything interesting; for example, they would be unable to explain their instances. Lewis's Humean supervenience claim says that laws depend on the pattern of their instances and other matters of particular fact (things possessing properties). This seems to get the relationship between laws and matters of particular fact the wrong way round. It is laws that direct or explain the matters of particular fact, not vice versa.

The nomic necessitation view of Armstrong *et al.* gives laws much more ontological robustness. Laws are themselves a certain kind of *sui generis* fact. Matters of particular fact are composed of particulars (individual things) possessing universals (natural properties, including relations). Facts may also be composed of universals themselves possessing or being related by higher-order universals. Laws are facts of this higher type. The law that Fs are Gs is a matter of the universals F and G being related by a specific second-order relation, that of *nomic necessitation* ('N'). The idea of nomic necessitation is that when two universals are related by it, then the presence of the first brings about the presence of the second. Thus laws do explain their instances and the existence of regularities in the world. However, against this view it is complained, what exactly *is* nomic necessitation? And how does it do what it is alleged to do? As Lewis (1983*b*: 366) quipped, 'It [necessitation] cannot enter into them [connections between particulars] just by bearing a name, any more that one can have mighty biceps just by being called "Armstrong".' I put this complaint on a more formal and precise footing and show that no higher-order universal could do what nomic necessitation is supposed to do unless the third view of laws were also true.

What is this third view? To understand it best, look again at the second, nomic necessitation view. According to that view, laws are imposed upon properties. In one possible world two properties may be related by N whereas in some other world they might not be. There is nothing in any property that allows or prevents it being so related to another property. The third view, *dispositional essentialism*, denies this. Dispositional essentialism takes its cue from a proposal by Sydney Shoemaker (1980) concerning the nature of properties, was developed as a view of laws by Chris Swoyer (1982), and has more recently been extended and promoted by Brian Ellis (2001, 2002). (A similar metaphysics is expounded by Harré and Madden (1975) and latterly by Molnar (2003).) According to this view laws are not thrust upon properties, irrespective, as it were, of what those properties are. Rather the laws spring from within the properties themselves. The essential nature of a property is given by its relations with other properties. It wouldn't be that property unless it engaged in those relations. Consequently those relations cannot fail to hold (except by the absence of the properties altogether, if that is possible). The laws of nature are thus metaphysically necessary.

We may describe a position as Humean if it denies the existence of necessary connections in nature. The three views of laws are thus fully Humean, semi-Humean, and anti-Humean. I call Armstrong's view *semi*-Humean because on the one hand it invokes nomic necessitation in nature, and so cannot be a vanilla kind of Humeanism while on the other hand nomic necessitation is entirely contingent. Its necessity isn't metaphysical necessity, and so isn't a complete break with Humeanism. Since it invokes an intermediate kind of necessity, it is a position that is in a sense intermediate between a fully Humean and an anti-Humean position. My criticism will be, in effect, that this intermediate position is unstable. Its spirit is willing—it wishes to have the ontological resources sufficient for explanation and the like, and thus wishes to find necessity in nature. But its flesh is weak—by making nomic necessitation metaphys-

ically contingent it ultimately has no more resources than the regularity theory. To acquire resources sufficient to its aim it needs full metaphysical necessitation.

There is clearly a difference in opinion concerning the nature or essence of what properties are. According to dispositional essentialism properties have distinct natures, given by their relations with other properties. But according to the first two views, such relations do not characterize the natures of properties, since the same properties may not be so related in some other possible world. Indeed, there is very little on these views to the nature of a given property and certainly nothing that would distinguish it from some other property. The identity and distinctness of properties is a brute fact, not grounded in qualitative differences. Such a view of the nature of properties is called *quidditism*. I argue that quidditism suffers from problems that make it a less attractive view of properties than the dispositional essentialist alternative.

What exactly is the nature of a property according to dispositional essentialism? In what way does a property essentially relate to other properties? The principal idea is that this essential relation can be characterized *dispositionally*. We are all familiar with dispositional talk, we talk about things being fragile or combustible and of people as being irascible or disposed to catch cold easily. Very roughly, a disposition ascription means that the object would give some characteristic manifestation in response to a certain kind of stimulus. The fragile vase would break if struck, the irascible man would get angry even if only slightly provoked, and so forth. The dispositional essentialist holds that the essence of a property can be characterized in these dispositional terms. The relationship of dispositions to conditionals explains why this yields an explanation of laws. For example, if the essence of the property of being negatively charged is a disposition to attract positively charged objects, then all negatively charged objects will attract positively charged objects. In some such cases the law yielded will be a *ceteris paribus* law. This arises because the relationship between disposition and conditional is imperfect—the conditions under which the relationship breaks down are precisely the conditions captured by the *ceteris paribus* condition.

Properties whose natures are described by quidditism are traditionally known as *categorical* properties; to those properties that have dispositional essences, I give the name *potencies*. Given these two views about the way any property may be, there are three views about all properties: that all properties are the one; that they are all the other; and that there are some of both kinds. *Categorical Monism* is the view that all properties are categorical. *Dispositional Monism* is the view that all have dispositional essences—they are all potencies. The *Mixed View* is the mixed view. The mixed view and dispositional monism are not so far apart, insofar as they both have to argue against categorical monism, which has held sway until recently and which is a feature of both Lewis's Humean view and Armstrong's semi-Humean view. To accept any essentially dispositional properties is to be anti-Humean. (See Table 1.1 for a representation of the commitments of the various views.) Dispositional monism has some advantages over the mixed view, principally that it can employ arguments against

<table>
<tr><td>fully Humean</td><td>semi-Humean</td><td colspan="2">anti-Humean</td></tr>
<tr><td colspan="2">laws are contingent
(with contingent necessitation)</td><td colspan="2">laws are necessary</td></tr>
<tr><td colspan="2">categorical monism</td><td>mixed view</td><td>dispositional monism</td></tr>
</table>

TABLE 1.1.

quidditism, ruling out any categorical properties. One the other hand it has the extra burden of showing how it is possible for every property to be a potency.

The aim of this book is to articulate and defend dispositional monism, plus the account of laws it engenders (laws as metaphysically necessary) while in the process criticizing categoricalism about properties and the two contingentist views of laws that may accompany it (the regularity theory and the nomic necessitation theory). Although dispositional essentialism about laws and properties and the concomitant necessiatarianism have been discussed elsewhere, I aim here to give the views their most detailed and coherent defence to date.

In describing just three views, in effect Lewis's view, Armstrong's view, and the one I share with Swoyer and Ellis, it may seem that I am ignoring other important theories of laws. In a sense I am, but I do not regard those other theories as being further options along the same spectrum. Other theories tend to concern the detailed characterization of laws. Either such theories are committed to something like one of the three views here canvassed or they are independent of these three in that the theory in question concerns a superstructure that could be built on any satisfactory metaphysical underpinning. I am primarily concerned with the underpinning rather than the superstructure. As regards the underpinning I think there are really only three options or category of option: a Humean account, a semi-Humean account, and an anti-Humean account.

For example, I do not discuss at length Jim Woodward's (1992) view of laws, important though it undoubtedly is. Woodward claims that laws are invariances under certain interventions. A relation between two variables may change under changes in the world, e.g. the mean distance between the Earth and the Sun would change if we could divert the Earth from its current orbit. But the orbit would remain an ellipse (to a second approximation). Hence the fact that the Earth's orbit is elliptical is an instance of a law (that planets have elliptical orbits), but the fact that the Earth's mean distance from the Sun is 150 million km is not an instance of a law. This is, I think, an

important contribution to understanding the superstructure. Nonetheless it does not tell us (nor is it intended to tell us) about the metaphysical underpinning; as Stathis Psillos (2002: 184) puts it, 'no laws in, no laws out'. Psillos points out that it is the laws that determine which interventions are physically permissible. Furthermore, invariance is a counterfactual characteristic—the relationship would remain unchanged *were* a certain intervention to take place. But what makes the counterfactuals true? A common answer is that it is the laws of nature. Even if we don't give that answer, it is clear the Woodward's account leaves unanswered the question: What underpins these invariances? Conceivably supporters of any of the three views could give an answer to that question. In fact Woodward himself appeals to *capacities*. Capacities, in this context, are most strongly associated with the work of Nancy Cartwright (1989). But as Psillos (2002: 192-6) complains, Cartwright's account lacks detail concerning the metaphysical character of capacities. Nonetheless, it seems that capacities are intended to be close to potencies. In which case Woodward's preferred metaphysical underpinning is the one I present here.

1.2 An outline of this book

The dispositional essentialist view of a natural property says that it is essentially a dispositional property. Chapter 2 has two purposes: to discuss what properties are, and to explore what dispositions are. The significance of the first is that this book is concerned with *natural* properties (what Lewis call *sparse* properties), as opposed to properties conceived of as concepts or as corresponding to predicates (*abundant* properties). My claim will be that a subset of the natural properties, the fundamental properties of physics (and possibly non-fundamental natural properties besides), are potencies. And so the second task of the chapter is to introduce the notion of dispositionality and to discuss the debate surrounding the analysis of dispositions. Here the key is to identify *finks* and *antidotes* as obstacles to a simple understanding of the relationship between dispositions and counterfactual and subjunctive conditionals.

In Chapter 3 I introduce the claim that fundamental properties are potencies—they have dispositional essences—and go on to show how this allows the essences of properties to provide an account of the laws of nature. Since laws flow from the essences of potencies they must hold in every possible world, at least in every possible world where the potencies exist. Thus the laws of nature are necessary. I examine this consequence in detail, and consider extending it to the claim that all possible worlds have the same laws.

A simple relationship between dispositions and conditionals allows for strict laws while the existence of finks and antidotes accounts for *ceteris paribus* laws. An interesting question is whether the fundamental laws of nature are all strict laws. This amounts to the question, are the fundamental potencies ones that suffer from finks and antidotes? I show that we can exclude the possibility of fundamental finks although matters are less clear when it comes to the possibility of fundamental antidotes.

Having laid out the dispositionalist position, I motivate it in Chapter 4 by showing the weakness of the opposing categoricalist account of properties and laws. The cat-

egoricalist view of properties involves a commitment to quidditism. The weakness of quidditism is exposed by employing an analogue of Chisholm's (1967) argument against haecceitism (the corresponding view for particulars). Quidditism allows for the swapping of nomic and causal roles. According to the quidditist, the original and swapped worlds are genuinely distinct, which is counterintuitive. Furthermore, quidditism allows for distinct properties possessing the same nomic role, in which case we could never know that we have one law, for there always might be two or more exactly parallel laws.

As mentioned, categoricalist accounts of law come in two varieties, the regularity theory and the nomic necessitation account. I argue that neither of these is satisfactory. Since the shortcomings of the regularity theory have been widely discussed, I focus on two crucial weaknesses: the implausibility of Humean supervenience (the idea that the laws supervene on matters of particular fact) and the inability of regularities to account for the explanatory power of laws. Turning to the nomic necessitation view, I show why it is impossible for Armstrong's nomic necessitation, N, to explain regularities without invoking potencies. (Is it necessary that if N(F,G) then $\forall x(Fx \rightarrow Gx)$? If so then N is potency-like. If not, then the relationship between N(F,G) and $\forall x(Fx \rightarrow Gx)$ (for various F and G) is either an accidental regularity, in which case it is non-explanatory, or it is a matter of nomic necessitation, in which case we have a regress on our hands).

Potencies have two interesting features: they have a modal quality and they in some sense involve properties other than themselves. Using the non-fundamental property of fragility as an analogue, the fragile vase *would* break if struck, and so if fragility (like a potency) has a real essence, then that real essence, as instantiated in the vase, involves something other than itself, a breaking, and that breaking is a *non-actual* breaking (so long as the vase is not struck). Various objections to potencies may be raised on the basis of these features. First, it may be argued that in resting the essence of a potency on what *would* happen, there is insufficient grounding in what is actual (potencies have too little actuality to be real). Secondly, there is something fishy about the possession of a property involving something that doesn't in fact happen—there is too much of something non-actual for a potency to be be a genuinely natural property (potencies have too much potentiality to be real). In Chapter 5 I argue that the categoricalist view of Armstrong (who raises objections along these lines) suffers from exactly the same problems (indeed more so as regards the first problem). I argue that unless we are happy with Lewis-style modal realism we have to accept that modality is a feature of the actual world. (This goes for Armstrong as much as it does for me.) Indeed, I argue that modality in the actual world is the import of the Barcan formula and that there are good reasons for accepting the Barcan formula. The third, related, objection to potencies is that their involving properties and possibilities external to themselves is importantly like intentionality (when I am thinking about Napoleon I have a thought whose nature involves something external to me). But, says Armstrong, intentionality is a mystery and should be dealt with by explaining it away—and the same goes for potencies. At the same time, some sup-

porters of potencies have argued that the parallel with intentionality is an advantage. I argue that in fact it is neither, since the alleged analogy with intentionality is weak.

The fourth objection to potencies is an objection to them as the *only* fundamental properties, and is thus an objection to dispositional monism but not to the mixed view. Potencies are characterized in terms of other properties (their stimulus and manifestation properties). If potencies are the only properties then these other properties are also potencies and must themselves be characterized in terms of yet further properties. This would seem to lead to some pernicious regress or vicious circularity. This regress objection has been widely regarded as one of the most serious problems for dispositional monism (Swinburne 1980, Robinson 1982, Blackburn 1990, Lowe 2006). Nonetheless the argument has not been articulated in a way that is entirely clear and convincing. In Chapter 6 I examine the various versions of the argument on offer and conclude that it is most pressing when considered as a worry concerning the *identity* of properties if that identity supervenes merely on the structure of a network of properties. However, that objection raises a worry but does not prove that identity *cannot* supervene on structure. I show that if the relevant graph-theoretic structures are sufficiently asymmetrical in certain respects, then those structures can determine the identity of the properties in those structures.

Some fundamental properties (such as charge) look ripe for a dispositional essentialist treatment. But others do not, such as spatial and temporal properties. Such structural properties seem to be categorical, not essentially dispositional. In Chapter 7 I discuss the debate between Hugh Mellor (1974, 1982) and Elizabeth Prior (1982) concerning whether structural properties can be seen as dispositional in a straightforward way. I do not believe that they can be. Rather we have to look at the way such properties might figure in a fundamental physics. That perspective makes the prospects for taking structural properties to be potencies much more promising.

Dispositional essentialism requires that the laws of nature are necessary. This is the source of another alleged problem for that view. For we do have an intuition that the laws of nature are contingent. But this is a weak and unreliable intuition. In Chapter 8 I examine the nature of this intuition and explain the illusions that allow necessary falsehoods to appear as possible. The intuition can be seen to be unreliable, since even the categoricalist must admit that some laws are necessary (for different reasons), but intuition tells us that those laws are contingent also. Kripke has a strategy for explaining the illusion of contingency for necessary *identities*. I extend and modify this strategy to explain the illusion of contingency for necessary *laws*. Finally I consider the relationship between imagination and possibility and conjecture that the relationship between imagination and possibility need only be reliable for matters of particular fact, not for laws.

In Chapter 9 I consider the allegation from Stephen Mumford (2004) that there are no laws after all. Mumford's challenge is interesting, since he also accepts the existence of potencies. In his view this obviates the need for laws. Furthermore, science doesn't especially need some metaphysical category of laws, since there is no unity among the principles, generalizations, and rules of thumb to which science gives the name 'law'. Against this I suggest that a unity can be discerned that distinguishes

laws from non-laws in science and I use this to add detail to the account of laws as supervening on potencies.

While it is my aim in this book to articulate the case for dispositional essentialism, and for dispositional monism especially, in as much detail as possible, I neither hope nor expect to have the final word on the matter. In the final chapter I mention some of the additional questions that need to be addressed. A full account of Nature's Metaphysics would say something substantial about natural kinds. Other philosophers, including Ellis and E. J. Lowe (1989*b*, 2006) have accordingly given a central place to natural kinds in their ontologies. I have not, primarily because the principal task is to account for the cement and motor of the universe (potencies and the laws that supervene on them). Natural kinds ought to be explicable in terms of that more fundamental ontology. I sketch an account of how that might be. Much further work will need to be done in defending dispositional essentialism against criticism. One important source of complaint comes in the form of physical laws that do not, on the face of it, look as if they can be derived from potencies. This is significant, since this kind of metaphysics should be modestly naturalistic. If there is a contradiction between the physics and the metaphysics, then the metaphysics must give way. That said, a *prima facie* tension does not amount to a contradiction, and the key is to indicate how plausible developments in physics may dissolve the tension.

2

DISPOSITIONS

One of the central theses of this book is that the fundamental natural properties have an essentially dispositional character. To understand this claim fully requires some further explication that it is the purpose of this chapter to provide. For example, what is meant by saying that a property or its nature is *dispositional*? I need also to say something about what a natural property is, which is where we start.

2.1 Properties

2.1.1 *Natural properties*

Philosophers can be pretty fast and loose with the term 'property'. A philosopher might say something such as: 'consider the property of being either square or red'. In this sense the set of properties is at least as large as the set of predicates.[3] That is, there is a property for every predicate or open sentence, and possibly more properties besides (for example, corresponding to predicates not yet in use, or even more liberally, to any set of objects, where that set would be the extension of the property).

That liberal use of the term 'property' contrasts with the more restricted use. For example, a scientist may discover or synthesize a hitherto unknown molecule. It would be natural to say that her next task is 'to discover its properties'. In that sense, its properties do not include 'the property of being first synthesized on a Wednesday' or 'the property of being Φ' (where something is Φ iff it is a member of the set {molecule *m*, the Eiffel tower, the power set of the natural numbers}). Following Lewis (1986*b*) we may distinguish the liberal from the restricted use of 'property' by referring to 'abundant' and 'sparse' properties. Or we may talk of 'natural' properties to capture the restricted sense. I shall use 'sparse' and 'natural' interchangeably. What follows in this book makes the following assumptions:

> (i) There is a genuine difference between abundant and sparse (non-natural and natural) properties.
> (ii) This difference is reflected in ontology. (I shall claim that sparse, natural properties are universals. But the claim that natural properties are

[3] That a distinct property corresponds exactly to every predicate with a distinct extension is Lewis's (1983*a*: 350) proposal. But this comprehension axiom for properties leads us straight into Russell's paradox. (This is one reason why I regard sparse, natural universals as genuine entities but do not think of what abundant properties as universals at all, or indeed as any kind of entity.) Lewis's other view that abundant properties are sets or classes is preferable.

> classes of perfectly resembling tropes would also mark an ontological difference between natural and non-natural properties.[4])

I shall not argue at any great length for these assumptions, assumptions which are in any case shared by all the principal participants (e.g. Armstrong, Lewis, Ellis, Swoyer, Molnar, Mumford) in the debate to which this book is a contribution. Nonetheless, I'll make a few remarks that provide partial justification of the assumptions I am making.

For a start, intuition tells us that there is a distinction between non-natural (abundant) properties and natural (sparse) ones. A common reaction to Goodman's term 'grue'[5] is to declare that it does not designate a natural (some might say 'genuine') property, while green is a natural property. We should distinguish the deliverances of intuition on the general question 'Is there a distinction between natural and non-natural properties?' and on the specific question, 'On which side of the distinction do grue and green fall?' Intuition is far from reliable, especially in metaphysics. But it does count for something and in this case one might expect intuition to be more reliable precisely because, from a naturalistic perspective, our cognitive systems, like those of other animals, have evolved in large part as property-detection systems: animals have evolved capacities to distinguish the edible, dangerous, or fertile from the poisonous, safe, or infertile (in order to decide whether to eat, to run, or mate as the case may be) and we detect these properties by their correlation with other properties we can more easily detect. Furthermore, we are able to distinguish real from apparent properties: our visual systems are good at tracking fixed and intrinsic colour (i.e. surface reflectance) properties despite changes in appearance due to changes in lighting conditions. Thus if there is a genuine distinction between natural and non-natural properties, it is no surprise that we intuitively think there is, and the former constitutes a good explanation of the latter fact. When intuition gives a verdict on some specific question, such as the classification of grue and green, that intuition may provide *prima facie* grounds for the corresponding belief, but those grounds are defeasible and just as our innate cognitive capacities are supplemented and corrected by science, our intuitions regarding the naturalness of specific properties may be overturned by the results of empirical investigation. It is possible that science could tell us that $\text{grue}_{t=2050}$ is a natural property (though I doubt it will). And it is certainly true that science tells us that colour properties if natural are nonetheless much more complex natural properties than we may have thought.[6]

The natural versus non-natural property distinction allows us to make further distinctions that it is important to be able to make. For example, Langton and Lewis

[4] Tropes (abstract particulars, property instances) are entities akin to universals except that there is a distinct trope for each instance of a property. See Williams (1953) and Campbell (1990). And see Daly (1997) for criticisms of tropes.

[5] Goodman (1954: 74): x is grue iff x is green and first observed before t, or x is blue and is not first observed before t.

[6] And even if we think that colour properties in general are natural properties, one might hold that our common colour classifications (green, blue, red etc.) are unnatural since their boundaries do not follow any natural divisions.

(1998) use it in order to analyse the notion of an intrinsic property (sparse or abundant). Their analysis depends on the notion of a duplicate of an object, where duplicates share natural properties. While I have my reservations about precisely this approach to defining intrinsicness (see below Section 7.4), Langton and Lewis are surely correct to hold that duplicates should share natural properties, but need not share all non-natural properties. Perfectly matching emeralds will both be green but one may be grue and the other not, if the one has been observed before t and the other has not. As mentioned, the distinction is also made by all those seeking to account for the laws of nature. For Armstrong, laws just are relations among natural properties. According to Lewis's rather different account, laws are regularities that are consequences of an optimal systematization of all the particular facts. Optimality involves simplicity, but the syntactic simplicity of an axiom system will depend on the language in which it is framed. If laws are to be objective features of the world, the language of the system must be fixed, and according to Lewis the appropriate non-arbitrary choice of language is that in which the predicates refer to natural properties. According to Ellis and Swoyer—and this book—laws are reflections of the essences of natural properties and kinds. Even Mumford, who rejects laws altogether, appeals to natural properties to do the work others attribute to laws.

It is not surprising that the arguments and examples that support the natural versus non-natural distinction should make reference to science, for that distinction and the ability to talk about natural properties is essential to making sense of science, at least from a realist perspective. As I remarked above, science is often the search for and investigation of properties—and clearly these are natural properties. The scientific (realist) perspective gives us reason not only to make the distinction between natural and non-natural properties, but also to believe that this distinction is generated by an ontological division. It is not that properties are ontologically all on a par but may be categorized as natural or non-natural (as exemplified by the view that all properties are sets, but some sets are natural groupings and others are not). Rather the natural properties are of a different kind from the non-natural ones.

Continuing with scientific realism, consider the realist's response to the thesis of incommensurability according to which key terms such as 'mass' change their meaning during revolutionary scientific change. The realist typically asserts that there is a property *mass* that is the constant referent of the term despite change in theories using the term. Let us assume that all properties, natural or not, are ontologically the same. Note that for any natural property there are many non-natural properties that are minor variants on it, for example by having a slightly different extension. Given that, the question should be asked, why is it that 'mass' refers to the one property, not the other. Note that the realist rejects the view that a scientific term has a precise *definition* which is designed to pick out exactly the natural property, but which could be varied to pick out one of the non-natural properties. Rather, terms get their meaning by a causal or explanatory process involving their references. The scientific expression 'm_e' refers to the sparse property that is the mass of the electron. Let 'm_e*' refer to that abundant property that has the same extension of as 'm_e' (i.e. positrons and electrons) *except* some particular electron that comes into existence in the year 2050.

The ability of the terms 'electronic mass' or 'm_e' as used by scientists to refer to m_e rather than m_e* suggests that there is something different about the two properties that allows the reference-fixing (causal, explanatory) process to latch onto the former rather than the latter. If all properties were sets, it would be inexplicable why the natural set gets involved in the causal process but not the very similar non-natural sets.

The latter argument is an application of the more general argument that understanding causation requires not only a natural versus non-natural distinction but also an ontological difference. The property of being charged explains why the path of a moving electron curves when entering a magnetic field; but the property of being charged* (extension: all charged things except some particular future proton) does not explain this. But if both charge and charge* are properties on an ontological par, there is no explanation of why one has causal explanatory power but the other does not. Mere labelling the one as natural and the other as not cannot explain the difference. Natural properties differ in ontological kind from non-natural ones, and only the one kind has causal power.

One could take the view that only the natural properties are real entities, and that the non-natural properties are not really properties at all, since they are not really any entity. This would be analogous to the view that regards arbitrary mereological sums as non-entities. There is no object that is the sum of (has parts which are) Mont Blanc, David Beckham's left foot, and my copy of the *Philosophical Investigations*; likewise there is no property whose extension is precisely these three things. Or one could take the more relaxed view that the property and the mereological sum do both exist but they are different kinds of entity from the natural properties and objects. For the purposes of this book it matters not which approach one prefers, so long as the natural properties form an ontologically distinct class of entity. The view I take is that the natural properties—or some of them at least—are *universals*. (Most of my argument could survive replacement by any alternative view that makes natural properties ontologically different from non-natural ones, for example classes of perfectly resembling natural tropes, where a natural trope is ontologically different from a non-natural trope.) If U is a universal that is the property P, then one and the same entity, U, is a component of all the facts which are a matter of some object having the property P. There are two principal conceptions of universals, the Aristotelian *in re* conception, which takes a universal to be actually present in all in instantiations, and so to have the capacity to be in more than one place simultaneously, and the Platonic *ante rem* conception, which holds universals to be entities that themselves exist outside space and time. The former requires each universal to be instantiated at least once, the latter permits uninstantiated universals. For the most part, the argument of this book could accept either view, though I shall explore the consequences of the Platonic view (which allows all possible laws to hold in all possible worlds) in the next chapter (Section 3.2.2) and so will elucidate there some of the reasons for preferring that view.

The category of universals is usually regarded as a distinct category from that of particulars. What they have in common is that they combine to form facts.[7] A simple fact will involve the combination of a particular and a monadic universal (a universal that attaches to a single particular, such as the universal that is (or corresponds to) the property of being green), or of a pair of particulars and a dyadic universal (e.g. the relational property of *having a greater mass than*), and so forth.[8]

An important question, but one which I will not address at length here, asks whether *all* natural properties are universals. It is not obvious that complex natural properties need universals, since one may argue that the simple underlying universals are doing the metaphysical and explanatory work. The term 'natural' is commonly used as a comparative; some things are more natural than others, and arguably this is true of properties: 'having electronic charge' designates a more natural property than 'is made of plastic', which in turns designates a more natural property than 'is an object owned by the Queen'. One might think that this comparative notion is basic, and the fully natural properties are those that occupy one extreme on this continuum. But the very existence of the continuum is in tension with the idea that natural properties are ontologically distinct from non-natural ones. Even if the natural ones are all at the extreme, it seems odd, without further explanation, that those properties very close to the extreme should lack the ontological status of those at the extreme. A better explanation of the continuum of naturalness is that there is a basic naturalness and comparative naturalness is derived from this; properties with basic naturalness are fully natural properties and that the continuum depends on the degree to which the rest approximate the fully natural ones.

The fully natural properties are those that are universals, and these include at least the fundamental properties. The fundamental natural properties are those with non-redundant causal powers. More generally these fundamental properties participate in (or generate) the laws of nature which in turn ensure that certain properties combine in clusters or that certain kinds of object combine in complex objects or that certain kinds of process occur; and these may be combined in yet more complex properties, objects, and processes. The corresponding complex properties (including the properties of belonging to the various kinds of complex object and process) may be regarded as more or less natural, being the outcome of processes and principles of combination that are themselves natural. At this point we may identify a conservative view and a more liberal view. According to the former, the distinction between these complex natural properties and less natural properties is not an ontological one. The ontological distinction is between the fundamental natural properties and the rest. For example, there is no universal corresponding to the property 'being an electron' in addition to the universals for the properties of possessing electronic charge and possessing electronic mass. The more liberal view will hold that there is such a universal, and will maintain that there are modal relations among universals: instanti-

[7] The view I take is that put forward by Armstrong (1978*b*, 1997). He writes 'state of affairs' where I use 'fact'.

[8] The fact has the particulars and the universals as constituents but is not identical to their sum, since the latter can exist without the former. Thus for Armstrong (1997: 28) universals are state-of-affairs types.

ating the universal of being an electron will entail instantiating the other two universals.[9] In this case, the continuum of naturalness will start among the non-natural properties, according to the degree to which they approximate to the natural properties.

The liberal-conservative difference reflects a tension noted by Jonathan Schaffer (2004) between the different explanatory roles attributed above to sparse properties: accounting for objective similarity and for causality on the one hand and providing a minimal ontological base for everything else on the other hand. The liberal view corresponds to privileging the first and the conservative to preferring the second. Schaffer's principal reasons for preferring the liberal view are (i) that fundamental properties are not enough to fill the similarity and causality roles, and (ii) that it is highly questionable whether there is a fundamental level. As regards the first, the conservative can claim that the causal powers of macroscopic objects, which we attribute to their macroscopic (non-fundamental) properties, are in reality reducible to the causal powers of their basic parts and their fundamental properties. However, responds Schaffer, such a move is not available in the case of mental properties (which are entirely legitimate, being required for the purposes of explicating objective natural similarity and causality), since these may be multiply realized. This takes us to much-discussed issues beyond the remit of this work. The right response in my view is to point out that if Schaffer is right then mental properties have non-redundant causal powers and should be regarded as fundamental. This would not be to reintroduce dualism, since the distribution of fundamental-but-also-mental properties will nonetheless supervene on the fundamental-and-also-physical properties.[10] In effect we distinguish two senses of 'minimal'—properties may be required for the minimal base upon which all else supervenes, or they may be minimal in the sense of being the non-redundant basis of causal relations. The former may be a subset of the latter, in which case the latter are the fundamental properties for the purposes of this book.

If there is no fundamental level, but there is infinite descent of levels, then the conservative view would seem to be ruled out. But then, for that matter so too would the very aim of this book, which is to give a general account of the nature of fundamental properties. I side with Lewis in regarding infinite downward complexity as far-fetched (cf. Schaffer 2004: 97). Schaffer (2003) does argue there there is no compelling evidence for there being a fundamental level. But Schaffer's argument is directed primarily against the idea that there is a fundamental level of *particulars*, and so is for the most part consistent with there being a fundamental level of properties. Imagine that below a certain level everything is made of infinitely divisi-

[9] Even the conservative view is likely to be committed to modal relations among universals, since the universals that correspond to parallel determinate properties of a single determinable will be necessarily mutually exclusive (e.g. the universal of electronic mass necessarily excludes the universal of protonic mass).

[10] As Jon Jacobs has pointed out to me, certain forms of emergentism urge that it does not follow from the causal non-redundancy of fundamental properties that the fundamental properties are all fundamental physical properties.

ble gunk. Then there are no atoms. But there may still be fundamental determinable properties—different sized chunks of gunk will possess different determinate values of the determinable, but the family of codeterminates may still be fundamental.[11]

Epistemically, the conservative view has the advantage that it is not obliged to answer the question, how is it that complex natural properties come to be universals in addition to the fundamental ones. The liberal view has at least the pragmatic advantage that while we know some natural properties, we are not yet sure that we know any fundamental properties. Thus the liberal view holds that we do know some universals; the conservative view cannot be so confident. That advantage means that it will sometimes be convenient to talk as if the liberal view is correct. But in fact there is no need to commit myself beyond the conservative view. Since the supervenience basis for all the natural properties and laws are the fundamental ones, this book focuses on the fundamental natural properties and how it is that they generate the natural laws upon which all the rest supervenes.

2.1.2 *Nominalism and realism*

The *nominalist* denies that there is a numerical single entity present in the explanation of numerically distinct behaviours of numerically distinct particulars. For the (resemblance) nominalist the basic notion is that of resemblance. Sometimes resemblances will be explained, but that explanation will refer to deeper resemblances. Some resemblances will be brute and fundamental. Armed with resemblance we do not need to expand our ontology beyond particulars to include the distinct category of universals.

The realist response is twofold. First, it is resemblance that needs explaining. When there is resemblance it is natural to want to explain it, and to explain it in terms of something held in common. Explanations may have to end somewhere, but ending in brute resemblance seems unsatisfactory. Secondly, and more importantly, resemblance itself looks like a universal, as Russell points out in the eponymous regress argument (Russell 1912/1967: 55). Consider three white objects **a**, **b**, and **c**. The nominalist tells us that each resembles the other. If we say that the resemblance between **a** and **b** is one and the same as that between **a** and **c** and as that between **b** and **c** then resemblance is a universal. If these three resemblances are not the same, we have to posit three further resemblances between those resemblances. Now we have a regress of resemblances.

Is this regress vicious? There is some debate over this. In my view the regress is vicious, not because there is a hierarchy of resemblances (that is entirely permissible), but because the ability of one level in the hierarchy to do the work required of it depends on exactly analogous work being done at the next level up. What constitutes or explains the existence of the property *whiteness*? It is not a universal *whiteness*. It is the resemblance of all white things to one another. Although we can talk of the relational property $resemblance_1$ (the subscript indicates that it is a relation at level

[11] More worrying for my assumption of a fundamental level of properties would be a world where there were infinitely descending levels of *kinds* of particular. For then there may not even be a set of fundamental determinables.

1 in the hierarchy), there is no universal *resemblance*$_1$, rather there is a multiplicity of facts of resemblance between the white objects. So what constitutes this relational property? It is resemblance$_2$ among the facts of resemblance$_1$. The resemblance facts at level n are constituted by the resemblance facts at level n+1. But that leaves the constitution of the property *whiteness* unexplained. The facts of resemblance among white things and hence the extension of the property are rendered indeterminate.

We may see that the problem is one of indeterminacy as follows. There are many relations holding between **a** and **b**, **b** and **c**, and between **a** and **c**. The property *whiteness* is determinate if it is determinate which of these relations are resemblance$_1$ relations. What determines which of these relations count as resemblance$_1$ relations? It is that they bear a second-level resemblance to one another.[12] Call this 'resemblance$_2$'. But that relation is determinate only if it is determinate which second-level relations are resemblance$_2$ relations. At each level the determinacy of the property or relation we are interested in depends on the same kind of determinacy existing at the next level up. In which case nothing provides the determinacy that is being looked for. To emphasize this point we imagine collapsing this hierarchy. We declare that there is no distinction in kinds between first-level relations, second-level relations, etc. We have one big set of relations, some of which are the resemblance relations that do the work for the resemblance nominalist; let us call the class of the resemblance relations $\Re$. What then determines the extension of $\Re$? That is, let **a** and **b** be related by some relation R—what then makes R a member of $\Re$? R will have to stand in some resemblance relation R′ to some perhaps canonical member of $\Re$. But that depends on its being determinate that relation R′ is in $\Re$. And that is just the problem we started with. What determines the extension of $\Re$ depends on $\Re$'s being determinate in the first place. The question, 'what determines $\Re$?', is given a circular answer. This circularity demonstrates that the uncollapsed hierarchy is a vicious regress.

I will now briefly mention the nominalist response given by Gonzalo Rodriguez-Pereyra (2002). Russell's regress seems to show that for **a** to resemble **b** we need not only **a** and **b** but also a universal of resemblance. Rodriguez-Pereyra's response is that **a** and **b** are themselves sufficient truthmakers for the proposition that **a** resembles **b**. He employs the following truthmaker principle (2002: 39):

> (T) If $E_1,\ldots, E_n$ are joint truthmakers of 'S' then 'E_1 exists &…& E_n exists' entails 'S'.

Let us assume that it is true in a world w that **a** resembles **b**. In this case (T) requires:

> (T1) If **a** and **b** are joint truthmakers of '**a** resembles **b**' then '**a** exists & **b** exists' entails '**a** resembles **b**'.

Since he says that **a** and **b** are themselves (jointly) sufficient truthmakers, Rodriguez-Pereyra is committed to the following:

> (E) '**a** exists & **b** exists' entails '**a** resembles **b**'.

[12] Anthony Everett has suggested that the need for higher levels of resemblance might be obviated if resemblance$_1$ is a variably polyadic (multigrade) property. I am inclined to think that such a move ought to be disallowed on the grounds that unlike some irreducibly multigrade properties, a multigrade relation of resemblance is clearly equivalent to a conjunction of two-place resemblance relations.

The realist's challenge is that (E) is clearly false. We need at least an additional entity, a universal, on the left-hand side of the entailment. It is at this point that Rodriguez-Pereyra brings Lewis's Counterpart Theory (CT) into play (cf. Lewis 1968, 1986*b*: 192-220). According to CT particulars only ever exist at one possible world. David Beckham exists only in this world. In other worlds there are individuals that are very like David Beckham. But they are not identical to David Beckham. Rather they are (at best) his counterparts. Now let us see how this allows **a** and **b** to be sufficient truthmakers on their own for '**a** resembles **b**'. For (E) to be true the consequent proposition must be true in every possible world where the antecedent proposition is true. That is '**a** resembles **b**' must be true in all worlds where **a** and **b** exist. As we have seen, according to CT **a** and **b** exist only at one possible world—call it *w*. So, whether (E) is true is just a matter of whether '**a** resembles **b**' is true of *w*, which it is. As Rodriguez-Pereyra writes: 'if **a** and **b** exist only in one possible world and they resemble each other there, then "**a** exists and **b** exists" does entail "**a** and **b** resemble each other", for then the former cannot be true and the latter false' (2002: 116). Consequently, CT allows it to be the case that if it is true that **a** resembles **b** then the existence of **a** and **b** may indeed be jointly sufficient truthmakers for '**a** resembles **b**'. And so Rodriguez-Pereyra can say 'the Resemblance Nominalist can perfectly well maintain that the truthmakers of a sentence like "**a** and **b** resemble each other" are just **a** and **b** without abandoning the entailment between "**a** exists and **b** exists" and "**a** and **b** resemble each other" required by (T).'

The problem with this response is that by invoking CT in this way, the nominalist makes life far too easy and allows himself to prove too much. (E), claims Rodriguez-Pereyra, is true, so long as **a** does resemble **b**, because CT, in effect, restricts the required consideration of possible worlds to just one world, the unique world where **a** and **b** exist. If at *w* '**a** resembles **b**' is true then **a** and **b** exist at *w* and so, at the unique world where **a** and **b** exist, '**a** resembles **b**' is true. Thus, almost trivially, in all worlds where **a** and **b** exist it is true that **a** resembles **b**. But, if this is right, the very same restriction to consideration of a single world means that any true proposition concerning a particular will entail all true propositions. Consider:

(E1) 'David Beckham plays football' entails 'Snow is white'.

The same reasoning employed above makes (E1) true. According to CT David Beckham exists just at the actual world. So the only world at which the antecedent of (E1) is true is the actual world. Hence the consequent of (E1) is true in all worlds where the antecedent is true if the consequent is true at the actual world. Which it is. This proof of (E1) depends on no relationship between the antecedent and consequent of (E1) at all. All that is required is that the consequent be true and the antecedent refer to a particular. We can go further by noting that it is not even required for this that the antecedent proposition be true. Even a false antecedent proposition that refers to a particular that exists at the world where the consequent proposition is true will suffice for the truth of an entailment such as (E1). That is because CT, in restricting our attention to a single world has reduced entailment to material implication, and as we know, any material implication is true so long as either the antecedent is false

or the consequent true. But in that case it is hardly surprising that (E) comes out true. The trivialization of entailment is bad enough; what is worse is that (T) also comes out as trivial since its consequent is trivially easy to satisfy. In which case (T) cannot be called upon as an important fact about truthmaking on which the nominalist can base his defence.[13]

The forgoing gives some indication of the debate between the realist and nominalist, and my views on it, to which I shall add only one final comment.[14] My motivation for preferring realism is that I cannot see how a substantive or realist conception of the laws of nature can do without universals. Whether one conceives of laws as Armstrong does or as I do, laws, or what they flow from, are supposed to provide a *unified* explanation of the behaviours of particulars. Without universals the explanation of the behaviours of things lacks the required unity. According to nominalism the interaction between electron **a** and positron **b** resembles the interaction between electron **c** and positron **d**, but there is no one interaction type that they both instantiate. Consequently it is difficult to see how a law, regarded as a single entity, can account for both. This comes out most clearly in the picture of the world provided by Rodriguez-Pereyra, where all we have are the particular electrons and positrons. The nominalist is clearly committed, at best, to some regularity theory of laws, the inadequacies of which I shall briefly review in Section 4.3.

2.2 Dispositions

We'll now turn our attention to dispositions. Dispositions as I consider them here are a subset of *all* properties, abundant and sparse. While I hold that some dispositions are sparse properties, I am far from committed to thinking that all are (the disposition to emit a loud noise when squeezed does not look like a sparse property to me). The remainder of the chapter is largely independent therefore of the preceding part. The connection between the two parts is that both are required in order to understand the central thesis of this book—that the fundamental natural properties are essentially dispositional. What fundamental natural properties are has been addressed. Now we shall ask what it is for a property to be dispositional.[15]

We have a variety of ways of talking about the properties and qualities of things. Some are overtly dispositional while others are covertly dispositional. For example, one might say that someone with a weakened immune system is disposed to catch infections easily when exposed to bacteria or viruses or that something is disposed

[13] For a more detailed exposition of this objection see (Bird 2003*a*) and for a perplexing reply see (Rodriguez-Pereyra 2003).

[14] For further discussion I refer the reader to the following: on the realist side, Armstrong (1978*a*) and Armstrong (1989*b*); and on the nominalist side, Rodriguez-Pereyra (2002). There are other forms of nominalism, but I regard resemblance nominalism and Rodriguez-Pereyra's exposition of it as the best bet for nominalism.

[15] There is an abundant literature on dispositions and their analysis. Mumford (1998) is the definitive work, having superseded Prior (1985). For a discussion in a context similar to this one, see Ellis (2001: 106-41).

to break easily when stressed. Such locutions are overt or canonical dispositional locutions whereas the following are covert: so-and-so is immunodeficient, such-and-such is fragile. In the overtly dispositional ways of talking we employ locutions of the form 'is disposed to ... when ...' which employs a dispositional predicate. Or we may say 'has the disposition to ... when ...' in which case we are referring to a property by using a description. Overtly dispositional locutions are characterized by their reference to a characteristic *stimulus* and a characteristic *manifestation*. Thus if something is disposed to break when stressed, being stressed is the stimulus and breaking is the manifestation. Covertly or elliptically dispositional locutions do not refer explicitly to their characteristic stimuli and manifestations—they are frequently single words that in English have ending such as 'ile' or 'ible'—fragile, combustible, digestible. In summary we may make the following distinctions:

> (1) Covert (or elliptical, indirect) dispositional property names. These are names that are naturally taken to refer to dispositional properties—'fragility', 'combustibility', 'brittleness', 'elasticity', 'malleability' are among the philosophers' favourites. If the dispositional account of mind is correct, then many mental property terms fall into this category: 'fearing ...' or 'fearfulness', 'loathing', 'hoping', 'having faith', 'being charitable', etc.
> (2) Covert dispositional predicates. These are predicates that correspond to the names in (1), such as 'fragile', 'combustible', 'brittle', 'elastic', etc.
> (3) Overt (or canonical, direct) disposition property descriptions. These are descriptions of properties of the form 'the disposition to M when S' where M is the description of a manifestation and S is a description of the stimulus condition, for example 'the disposition to break easily when stressed'.
> (4) Overt dispositional predicates. These are locutions of the form 'is disposed to M when S' (M and S as above).

Clearly there is a correspondence between (1) and (2). Something is fragile iff it possesses the property of fragility, is elastic iff it possesses the property of elasticity, and so on. Similarly, it would be natural to regard (2) and (3) as two sides of the same coin, claiming that:

> *x* possesses the disposition to M when S iff *x* is disposed to M when S

It might be objected, however, that one ought to restrict the left-hand locution, the overtly dispositional property description, to natural properties, in which case the right-hand may hold without the left hand holding. I think that such a restriction is unhelpful, and that we should accept the biconditional (and so I shall symbolize both as: $D_{(S,M)}x$). We can then ask as a separate question, which dispositional properties (as described by locutions given by (3)) are natural properties?

One reason for adopting this policy is that the same question inevitably arises for the properties referred to by the covert dispositional property names falling under (1). These terms clearly name properties, but do they name natural properties? There is no reason to suppose that they all do. After all many property names clearly do not name natural properties ('being phlogisticated', 'grue', 'Swiss') and those include

dispositional property names ('corruptibility', 'sensitivity' (used as a technical term to denote the alleged susceptibility of a person to the paranormal), etc.).

Philosophers have often assumed that there is a simple correspondence between dispositional property names/predicates in (1)/(2) and the descriptions/predicates in (3)/(4), that every covertly dispositional locution is straightforwardly equivalent to some overtly dispositional locution. For example, one might think that something that has the property of being elastic can be characterized as displaying the manifestation of stretching without deformation in response to the stimulus of being put under tension, or that fragility just is the disposition to break easily when stressed. At a more fundamental level inertial mass may perhaps be characterized as the disposition to respond to the stimulus of a force by accelerating in proportion to that mass. However, this assumption is not entirely uncontentious and there may some covertly dispositional terms for which there are no easily specifiable characteristic stimuli and manifestations.

In fact it is far from easy to find entirely convincing pairs of manifestation and stimulus to correspond to the dispositional property names. For example, philosophers have often regarded fragility as the disposition to break easily when *struck*—evidently they have had the notorious and much-discussed fragility of vases in mind. But an old document may be fragile which it might manifest by tearing easily when its pages are turned. That is a manifestation of fragility even though there is no striking. Which is why I have said 'stressed' in the above. Furthermore, one might suspect that some dispositional property names are applied in a context-sensitive manner. For example, a old iron girder may be regarded as brittle by a building surveyor even though it is able to withstand much greater loads without shattering than my pencil which I do not regard as among the brittle objects in my office.

Indeed, as we shall see the questions of the relationship between the covert and overt locutions is a matter of debate when it comes to diagnosing certain problems in analysing dispositional concepts in non-dispositional terms. David Lewis (1997) and Sungho Choi (2003*b*) argue that alleged problems with the analysis of overt disposition terms, (3)/(4), arise because philosophers have focused their minds on locutions of the covert variety in (1) and (2). But if there is no easy transition from the covert to the overt locutions, then problems for the analysis of covert disposition locutions in non-dispositional terms do not imply the existence of problems for the analysis of overt disposition locutions.

So far we may conclude the following:

(a) Covert disposition names and overt disposition descriptions may both denote properties, but we should not assume that there is a straightforward analysis of the former in terms of the latter.

(b) Some such disposition terms may denote natural properties—that they do so would be shown by their playing a role in some true scientific theory (this would be at best a sufficient condition, not a necessary one).

(c) If a disposition term does denote a natural property then it may thereby denote a universal; if it does not, then it denotes a natural combination of universals.

I'll now proceed to a brief discussion of a further disposition-related concept.

2.2.1 *Multi-track dispositions*

Some dispositions are single-track dispositions, which is to say that they are characterized by a single type of stimulus and a single type of manifestation. Gilbert Ryle (1963: 114) alleges that there are also *multi-track* dispositions. The idea is that they might have more than one kind of manifestation or stimulus, or both. A common view is that mental dispositions are often multi-track. To use Ryle's example, knowing French seems to be dispositional, but its manifestations may be various—talking French, writing French, obeying an order given in French, or even changing mental state when reading or hearing something in French. If we allow multiple manifestations, then we should allow multiple stimuli. For example, when discussing fragility it was clear that the manifestation is some kind of breaking, but it was less clear how to characterize the stimulus. One possibility is that fragility is a multi-track disposition with several different stimuli—striking, shaking, lateral stress (as would result in tearing). If we can have multiple manifestations and multiple stimuli, then we might have disposition-like properties with both multiple stimuli and multiple manifestations. Indeed the example of knowing French looks like this, since the stimuli are also various. They include not only external stimuli, such as hearing or reading something in French, but also internal stimuli, such as a desire to communicate with a Frenchman. It has been suggested that electric charge is a multi-track disposition. The manifestation of charge is a force on some other charge, its stimulus is the magnitude of that other charge. For different magnitudes of the other charge (viz. different stimuli) a different force (viz. a different manifestation) is exerted.[16] Let us include among the multi-track dispositions all those which have multiple possible manifestations or multiple possible stimuli. Let us also call *complex* any disposition with either a logically complex stimulus or a logically complex manifestation.

Our first question is whether all multi-track dispositions can be regarded as equivalent to complex single-track dispositions; that is, can the multiplicity involved in a multi-track disposition be accounted for simply by the logical complexity of the stimulus or manifestation? In the case of a multi-track disposition with a single stimulus but multiple possible manifestations, the manifestations can be regarded as one disjunctive manifestation, and so we can easily assimilate this to the single-track case; similarly for a multi-track disposition with a single manifestation but multiple stimuli. Matters are more complicated when it comes to multiple stimuli and multiple manifestations together. Typically these cannot be modelled by the single-track disposition with both a disjunctive stimulus and a disjunctive manifestation:

> D is the disposition to manifest ($M_1 \vee M_2 \vee M_3 \vee \ldots$) in response to stimulus ($S_1 \vee S_2 \vee S_3 \vee \ldots$)

A disposition of which this characterization it true is one for which any of its possible stimuli could appropriately bring about any of its possible manifestations. That may hold for some multi-track dispositions, but it is clearly not correct for all. To the stimulus, 'Comment allez-vous?', the response, 'La plume de ma tante est dans my

[16] And charge may also be regarded as multi-track for the perhaps more decisive reason that a charged body is disposed to experience a lateral force when moving through a magnetic field.

poche' is not a manifestation of knowing French, although it might be in response to some other stimulus, such as 'Où se-trouve la plume de votre tante?'. If charge is multi-track, then for a given stimulus (another charge at a certain distance) there is only one permitted manifestation.

Let us call a *pure* disposition one which can, in principle, be characterized in the way that D is above, viz. as a relation between a stimulus and a manifestation, even if these may be logically complex, i.e. can be characterized as 'the disposition to F when G' for possibly complex F and G. Knowing French and charge (on the view proposed) are not pure dispositions. However, they do look like conjunctions of pure dispositions. Consider, for illustrative purposes, the case of charge. Let x be a real number that will act as an index, and let q_x be a charge, r_x a displacement, and F_x a force, such that, for a fixed value of Q:

$$F_x = \epsilon \frac{Qq_x}{r_x^2}$$

Now consider, for some specific x the pure disposition D_x, whose stimulus is a charge q_x at a displacement r_x and whose manifestation is the exertion of a force F_x. Then an object with charge Q has this disposition. That object also has all the other parallel dispositions for other values of x. Let us assume that the indexing by x is such that all permissible combinations for values of q, r, and F are indexed by some x in the subset I of the reals. Then the impure disposition that the object has, its having the charge Q, will be equivalent to the conjunction $\bigwedge_{x\in I}\mathrm{D}_x$, that is the conjunction of the D_x dispositions for all values of the index x. It should be noted that a conjunction of simple pure dispositions is not in general equivalent to some complex pure disposition. Later we shall come to the conditional analysis of dispositions, according to which a dispositional proposition is equivalent to a counterfactual. A conjunction of counterfactuals is not in general equivalent to some single but complex counterfactual. That is, if S_1 and M_1 are counterfactually related, and S_2 and M_2 are also counterfactually related, there are not always any S_3 and M_3 satisfying:

$$(\mathrm{S}_1 \mathbin{\square\!\!\rightarrow} \mathrm{M}_1) \wedge (\mathrm{S}_2 \mathbin{\square\!\!\rightarrow} \mathrm{M}_2) \Leftrightarrow \mathrm{S}_3 \mathbin{\square\!\!\rightarrow} \mathrm{M}_3$$

Consequently, if $\mathrm{D}_{(\mathrm{S}_1,\mathrm{M}_1)}$ and $\mathrm{D}_{(\mathrm{S}_2,\mathrm{M}_2)}$ are distinct dispositional essences, we cannot expect there to be a dispositional essence $\mathrm{D}_{(\mathrm{S}_3,\mathrm{M}_3)}$ equivalent to their conjunction. Thus if the conditional analysis were right, this would imply that we typically cannot find a single pure disposition equivalent to a conjunction of pure dispositions.[17] Impure multi-track dispositions are typically irreducibly multi-track.

While it will be possible to gerrymander impure dispositions of all sorts, it is clear as regards the cases we are interested in, charge and knowing French, that the conjunctions are natural or non-accidental. It is my view that all impure dispositions are non-fundamental. Fundamental properties cannot be impure dispositions, since such dispositions are really conjunctions of pure dispositions, in which case it would be the conjuncts that are closer to being fundamental. However, pure dispositions

[17] In fact we will find that the conditional analysis is false. Nonetheless there is a sufficiently close relationship between dispositions and counterfactual conditionals that this argument remains decisive.

may nonetheless be complex, and will include those pure multi-track dispositions with complex (disjunctive or conjunctive) manifestations. An interesting question is whether all complex dispositions, and multi-track dispositions in particular, are non-fundamental.

I will consider four cases of complex dispositions: (i) simple (atomic) stimulus, conjunctive manifestation; (ii) disjunctive stimulus, simple manifestation; (iii) simple stimulus, disjunctive manifestation; (iv) conjunctive stimulus, simple manifestation. (i) A multi-track disposition with a simple stimulus but with a conjunctive manifestation is equivalent to the conjunction of dispositions each with the same stimulus but with different simple manifestations (each one of which corresponds to one of the conjuncts in the original disposition). In which case it seems plausible to take the conjunctive disposition to be non-fundamental. (ii) Likewise, a disposition with a disjunctive stimulus is equivalent to a conjunction of dispositions each with a different simple stimulus corresponding to the disjuncts in the disjunctive stimulus. This is because the disjunctive stimulus says that the satisfaction of any of its disjuncts will bring about the manifestation, which is equivalent to possessing all of a set of dispositions with different simple stimuli. (iii) The case of a disjunctive manifestation cannot be regarded as equivalent to any compound of simpler dispositions. Nonetheless, we would typically not need to posit such a disposition. Let the stimulus be S and the manifestation be $(M_1 \vee M_2)$. Thus we find on certain occasions S yielding M_1 while on other occasions S yields M_2. Thus we would have no reason to posit the multi-track disposition rather than two single-track dispositions. For example, if striking glasses with a particular force sometimes leads to breaking and on other occasions leads to a bell-like ping, then we do not need to posit a single disposition whose manifestation is (breaking or pinging); instead some glasses have the disposition to break which struck with that force, and others have the disposition to ping.[18] (In this example one might prefer the single multi-track disposition if one thought that there was a single causal basis. But for fundamental dispositions there will not be a (distinct) causal basis.) (iv) In the case of a conjunctive stimulus, there is no option other than to regard this as irreducible.

Thus in two of the four cases we can simply replace the disposition by a conjunction of single-track dispositions. In the third case, we can posit multiple single-track dispositions in place of the multi-track disposition. Only in the fourth case must the logically complex disposition remain. This is the case of the conjunctive stimulus. And although I have included this among the multi-track dispositions on the grounds of complexity, it is certainly not the typical sort of case that one has in mind when talking of multi-track dispositions, where it is the plurality of manifestations that one has in mind. One would most naturally say that this is rather a case of a single-track disposition with a compound (conjunctive) stimulus. Some multi-track dispositions might have complex stimuli and manifestations. By putting the mani-

[18] An exception might arise when we have some theoretical reason for thinking that the objects in question are intrinsically alike, in which case we would not wish to ascribe different intrinsic dispositions. Such cases, I suggest, would be best assimilated to propensities, which are dispositions with probabilistic manifestations.

festation in conjunctive normal form and the stimulus into disjunctive normal form, we can use (i) and (ii) to break it into a conjunction of dispositions with disjunctive manifestations and conjunctive stimuli. Then (iii) allows us to posit instead just dispositions with conjunctive stimuli and simple manifestations. In conclusion we do not need to posit fundamental dispositions with any greater complexity than conjunctive stimuli. Since conjunctive stimulus requires all its components to be instantiated, a disposition of kind (iv) (unlike those of kind (ii)) cannot be regarded as have a multiplicity of possible stimuli. Thus we do not need to posit fundamental multitrack dispositions.

2.2.2 *The conditional analysis of dispositions*

As mentioned at the beginning of this chapter, I intend to explicate the claim that fundamental natural properties are essentially dispositional. We have seen which locutions we may regard as dispositional and so now I shall consider the import of such locutions and so will examine the analysis of dispositional locutions. Previous discussion of this topic has tended to assume that 'analysis' is meant in traditional terms, as supplying synonymous expressions composed of conceptually more basic expressions. While I think that this, in this instance, is an appropriate way of seeing what is going on, I shall commit myself only to the consideration of whether a certain biconditional holds necessarily.

We shall focus primarily on overt dispositions. These are characterized by their stimulus and manifestation conditions. It is often assumed that the relationship between stimulus and manifestation is one of subjunctive or counterfactual implication. Thus, if an elastic object were put under tension, then it would stretch without deformation; if an inertial mass were subjected to a force, then it would accelerate in proportion to that force. That is:

> *x* is disposed to manifest M in response to stimulus S iff
> were *x* to undergo S *x* would yield manifestation M.

This is known as the *conditional analysis* of dispositions, (CA), or sometimes the 'simple conditional analysis'. Let '$D_{(S,M)}x$' abbreviate '*x* is disposed to manifest M in response to stimulus S, and '$\Box\!\!\rightarrow$' symbolize the subjunctive/counterfactual conditional, so that '$Sx \Box\!\!\rightarrow Mx$' abbreviates 'if *x* were S it would be M'. Then the (simple) conditional analysis of dispositions may be symbolized:[19]

(CA) $\quad D_{(S,M)}x \leftrightarrow Sx \Box\!\!\rightarrow Mx.$

The consensus among those who have given (CA) serious consideration is that (CA) is false, although the proposed counterexamples are perhaps not as conclusive as they might at first appear. There are two kinds of counterexample to the left-to-right implication:

(CA$\rightarrow$) $\quad D_{(S,M)}x \rightarrow Sx \Box\!\!\rightarrow Mx.$

[19] In what follows, to minimize cluttering with brackets, I shall take '$\leftrightarrow$' to be the principal connective, and likewise the corresponding '$\rightarrow$' and '$\leftarrow$'.

These are *finks* and *antidotes* (or *masks*, in Mark Johnston's (1992) terminology[20]). There are also corresponding counterexamples to the right to left implication:

(CA←) $\quad D_{(S,M)}x \leftarrow Sx \mathrel{\Box\!\!\rightarrow} Mx.$

(where $p \leftarrow q$ is equivalent to $q \rightarrow p$, i.e. should be understood as 'p, if q').

2.2.3 *Finkish dispositions*

Charlie Martin's (1994) objection to (CA) centres on the existence of *finkish* dispositions. To understand finkish dispositions we must first note two characteristics of dispositional properties. First, the process whereby a disposition manifests itself will typically take time.[21] The poison ingested must interact with the vicitim's metabolism before it causes illness. The irascible man may be swift to anger but not literally instantaneously. A nuclear pile may be disposed to melt down if the boron control rods are removed, but the meltdown occurs only once the chain reaction has generated enough heat. Secondly, many such dispositions may be gained or lost. Some food may become infected with the bacterium *Clostridium botulinum* and thereby become poisonous. It can lose that disposition by cooking or irradiation. A person's moods change and they can become irascible having previously been placid and vice versa.

Finkish dispositions arise because the time delay between stimulus and manifestation provides an opportunity for the disposition to go out of existence and so halt the process that would bring about the manifestation.[22] More precisely an object's disposition is finkish when the object loses the disposition after the occurrence of the stimulus but before the manifestation can occur and in such a way that consequently that manifestation does not occur.[23] In Martin's example an electro-fink is a device that can make an electric wire live or dead. It also detects whether the wire is being touched by a conductor. Let us take 'live' to mean 'disposed to conduct a current when touched by a conductor'. Let the wire be live; it is properly connected to an electric generator. Let the electro-fink operate by making the wire dead (cutting the connection to the generator) whenever it is touched by a conductor. Thus the wire is live. But were the wire to touch a conductor, the electro-fink would cause it to become dead and it would not conduct a current.[24] So something can be live (disposed to conduct a current when touched by a conductor) yet it is false that if it were touched by a conductor it would conduct a current. In Lewis's example, a sorcerer

[20] Hawthorne and Manley (2005) suggest that 'In the literature, an antidote appears to be a species of mask that involves an actual change in external conditions resulting from the trigger [i.e. stimulus]. While this was not my intention it may be a useful distinction to make.

[21] Arguably it always does, but I do not wish at this point to exclude instantaneous action at a distance.

[22] A fink is the industrial opposite of an agent provocateur—he is a worker in the secret pay of an employer whose job is to dissuade his co-workers from striking. He removes the disposition to strike. The term 'fink' is mentioned in the context of dispositions by Blackburn (1993: 278), who attributes it to Lewis.

[23] Although we talk of finkish dispositions, it is not the disposition itself that is finkish but its instantiation at a particular time.

[24] To be entirely accurate, Martin focuses initially on (CA←) and so when he comes to discuss (CA→) he says that the electrofink is in its reverse cycle.

resolves to protect a fragile glass by ensuring that whenever the glass is struck a spell changes the microstructure of the glass in such a way that its fragility is lost. He does this before any shattering can take place, and thus prevents this from occurring. At the time of striking the glass is fragile, but it does not go on to shatter. Fragility is also sensitive to temperature. Warming something may make it less fragile, cooling it will make it more fragile. Consider some object just below the threshold for fragility (or some specific degree of fragility). Suppose that as soon as it is struck, it is very rapidly heated before the striking can have any significant effect and so that it is no longer fragile. Having lost its fragility, the object will not break, even though at the instant of striking it was fragile. Such cases show that an object can have a disposition without the corresponding conditional being true, that is (CA→) is false.

Finkishness can also show that the reverse implication in (CA), viz. (CA←) is also false. In such a case the disposition $D_{(S,M)}$ is absent, but its characteristic stimulus brings it into existence, and consequently brings its characteristic manifestation into existence also. Hence, at some particular time the proposition '*x* has $D_{(S,M)}$' may be false; nonetheless the proposition 'were *x* to undergo S, it would yield manifestation M' is true. Take the case of temperature-dependent fragility. We might now consider an object warm enough to be just above its threshold for fragility. On striking it is very rapidly cooled, so that it does become fragile. It acquires its fragility sufficiently quickly that the stresses of the striking, still being transmitted around the object, suffice to cause it to break. So it is true of this object that were it to be struck it would break, but at the instant of striking it is not fragile.

In all the examples discussed in the literature matters are set up so that the stimulus is also the cause of the loss of the disposition; hence we may think of finkish dispositions as a species of self-defeating disposition such that the disposition's own stimulus causes it to go out of existence. But for a counterexample to (CA) what is required is merely that the disposition just does disappear after the stimulus occurs, no matter why it does so; the cause of its disappearance may be entirely independent of the stimulus. Thus instead of causing the sorcerer to cause the glass to lose its fragility once it has been struck, a Laplacian sorcerer might be able to predict when it will be struck and set up a spell in advance that will remove the fragility at the right time, viz. fractionally after the striking. And it might indeed be that matters are set up in such a way *accidentally*; it happens just by chance that the glass rapidly loses its fragility just after being struck, for reasons entirely independent of its being struck. This we may call an *acausal* (instantiation of a) finkish disposition.

2.2.4 *Lewis's reformed conditional analysis*

(CA) is sometimes called the *simple* conditional analysis, to distinguish it from attempted reformations of (CA) that retain its spirit while evading counterexamples to (CA). The most promising of such is due to David Lewis (1997). Lewis argues that what is required for something to have a disposition is for it to have a certain sort of intrinsic property, the causal basis of the disposition. What happens in the finkish cases is that this intrinsic property (the causal basis) is lost, after the object suffers the stimulus but before the response comes into being. What is needed for the re-

sponse to occur is for the causal basis to remain for a sufficient time, and this is what Lewis's reformed conditional analysis requires. More formally:

> (RCA) Something x is disposed at time t to give manifestation M to stimulus S iff, for some intrinsic property B that x has at t and for some time t' after t, if x were to undergo stimulus S at time t and retain property B until time t', S and x's having of B would jointly be an x-complete cause of x's giving response M.

(An x-complete cause of y includes all the intrinsic properties of x which causally contribute to y's occurrence. This stipulation is required to rule out certain other finkish counterexamples.)

Consider the sorcerer's glass. As a matter of fact it never breaks, despite whatever knocks it receives, because its microstructure is altered before it can break. However, if it were to retain the microstructure that it starts with (i.e. if the sorcerer were not to interfere with the microstructure, nor anything else of that sort were to happen), then it would indeed break as a result of being struck. (RCA) clearly excludes finks and saves the spirit of (CA) from those counterexamples.

2.2.5 *Antidotes*

Not all counterexamples to (CA→) may be eliminated by excluding finks. For the operation of a disposition in bringing about its manifestation may involve features of the world extrinsic to the causal basis of the disposition; indeed they may be extrinsic to the bearer of the disposition. Many dispositions have what I call *antidotes*. Let object x possess disposition $D_{(S,M)}$. At time t it receives stimulus S and so in the normal course of things, at some later time t', x manifests M. An antidote to the above disposition would be something which, when applied before t' (and possibly before t), has the effect of breaking the causal chain leading to M, so that M does not in fact occur. Let us understand 'fatally poisonous' to mean 'disposed to kill if ingested'. It is possible to ingest a dose of a fatal poison yet survive if one has also taken an antidote. One way an antidote might work is to change the body's physiology in such a way that the poison does not have the effect it would normally have.[25] The poison is left unchanged, and *a fortiori* the causal basis of the poison's disposition to kill is left

[25] In Bird (1998: 228) I noted that the antidote to arsenic poisoning is dimercaprol, which is fortuitously (given the context of a response to Lewis) also known as British Anti-Lewisite. Jan Hauska (2005) adds the following helpful commentary:

> However, it turns out that, in spite of having the convenient name of British Anti-Lewisite, arsenic's antidote (better known as dimercaprol) does not really fit the profile of a masker [i.e. antidote]. Arsenic exerts its toxic influence by binding to certain enzymes and thereby preventing cellular metabolism. Dimercaprol interferes with or even reverses this process by binding even stronger to arsenic: it either binds to arsenic when the latter is still free or 'liberates' the enzymes from arsenic's close companionship, allowing them to proceed with their metabolic tasks.
>
> It seems that all this is best explained by recognizing that arsenic has a disposition to bind to the most exposed sulfhydryl groups, which figure prominently both in the enzymes in question and in dimercaprol. When arsenic comes near the enzymes and dimercaprol is absent, the disposition is displayed in binding to the enzymes. In the presence of dimercaprol, it is manifested in binding to the antidote. So, unlike finks, dimercaprol does not

unchanged. Therefore this is not the case of a finkish disposition. Rather, the environmental conditions are not appropriate for the poison to have the effect it would normally have. In such a case the antidote to the poison is an antidote in the philosophical sense, viz. something that interferes with the conditions that are normally appropriate to the functioning of the disposition. When an antidote is present an object can have a disposition to M when S yet fail to yield M when given stimulus S, because the conditions that, in conjunction with the disposition's causal basis, would normally bring M about, have been interfered with. When Lewis's sorcerer protects his glass, his strategy is finkishly to remove its fragility as soon as it is struck. But another way of protecting the glass once it is struck is to find an antidote to striking. The sorcerer, being a brilliant physicist, may be able to administer shock waves to the struck glass which precisely cancel out the shock of the original striking, hence saving the glass from destruction. Just as in the original finkish removal of fragility, the causal chain leading to breakage may have started—shock waves have begun to travel through the glass and minute fractures to appear. But before the glass breaks something interrupts the chain. In the finkish case, which Lewis has now provided for, it is the disappearance of the disposition. But he has not provided for the administering of an antidote. For the point of the antidote case, unlike the finkish case, is that the disposition remains.

We thus have another kind of counterexample both to (CA) and to Lewis's (RCA). In such cases the disposition and its causal basis remain throughout. The object in question receives the appropriate stimulus, but does not give the expected response. These cases therefore constitute counterexamples to Lewis's analysis. The analysandum is satisfied, but the analysans is not. The analysans takes the form of a conditional:

> For some intrinsic property B and time t'
>
> > *if* x were to undergo stimulus S at time t and retain property B until time t'

join forces with the activating conditions of a disposition to drive it out of existence. Nor, in contrast to genuine masking/antidote factors, does it prevent the disposition from being manifested. It simply triggers a harmless display of the disposition. (Cf. Amdur *et al.* 1991: 627-31, esp. 631.)

I am not sure that focusing on the disposition of arsenic to bind to the most exposed sulfhydryl groups tells us about the status of its disposition to poison. With the benefit of Hauska's information, I am inclined to regard the action of dimercaprol as borderline between finkishness and masking. On the one hand we may see it as finkish (and not as a philosophical antitdote or mask), since (a) it is the chemical nature of arsenic, indeed the same nature that makes it poisonous in normal circumstances, that causes it to bind with the sulfhydryl groups in dimercaprol, and (b) thus bound the arsenic has lost its basis for poisoning by reacting with the enzymes. On the other hand there is room for arguing that the arsenic remains unchanged but that the dimercaprol engages with the arsenic such that the latter is unable also to engage with the enzymes. That makes it look more like an antidote/mask. This is a borderline case because it is unclear whether it is a change in the arsenic that is responsible for preventing poisoning; this an issue that will ultimately turn on matters concerning the configuration of the electrons in the outer shell of the arsenic. If instead of arsenic we had a complex organic poison which was treated in such a way as to destroy the molecule before it causes illness, then that would be clearly finkish. If on the other hand the treatment changes the body's physiology (e.g. by lining the gut and so preventing digestion), then that is an antidote.

> *then* S and *x*'s having of B would jointly be an *x*-complete cause of *x*'s giving manifestation M.

In the antidote cases the antecedent is satisfied but not the consequent. For the causal basis of fragility remains and the glass is struck. But the causal basis and the striking are not jointly a glass-complete cause of breaking, since the glass does not break.

2.2.5.1 *Mimics and trivial counterfactuals* Shortly, in Section 2.2.7, we will consider whether (RCA) can be defended. Before doing so I will draw attention to the analogue of antidotes that refutes (CA←). These are mimics (Johnston 1992), so-called because they are circumstances that mimic the action of a disposition, in that they make the relevant counterfactual true. But there is no genuine disposition at all. For example, consider a robust iron cooking pot that is definitely not fragile. However it is attached to a powerful bomb with a very sensitive detonator. Should the pot be struck or dropped the detonator will cause the bomb to go off and the pot to shatter as a result. So the counterfactual, 'if the pot were struck, it would break' is true but it is not a fragile pot. Hence (CA←) is false. Such cases are, I believe, first mentioned by A. D. Smith (1977) in whose example a sharp tap on a sturdy block of wood causes powerful 'Z-rays' to be beamed onto the wood, which in turn cause it to splinter.

However, (CA←) can easily be seen to be false in a more trivial way (Bird 2003*b*: 158).[26] According to the Stalnaker-Lewis semantics for counterfactuals, if p and q are both true, then $p \mathrel{\Box\!\!\rightarrow} q$ is also true. (CA←) tells us that if we have a counterfactual we have the corresponding disposition. So if p and q are true then any object can be said to have the disposition to yield the manifestation that q in response to the stimulus that p. For example, if you in fact sneeze while reading this sentence, then you were disposed to yield the manifestation of sneezing in response to the stimulus of reading this sentence, even though the sneezing and reading are entirely unrelated.

2.2.6 *The intrinsic dispositions thesis*

In our exchange both Lewis and I accepted the intrinsic dispositions thesis, the claim that intrinsically identical objects have the same dispositions. As Lewis (1997: 148) explains, 'If two things (actual or merely possible) are exact intrinsic duplicates (and if they are subject to the same laws of nature) then they are disposed alike.' [27] Jennifer McKitrick (2003) has persuasively challenged the intrinsic dispositions thesis, citing the power to open a door, weight, the disposition to dissolve the contents of my pocket, vulnerability, visibility, and recognizability as examples of extrinsic dispositions. Take weight for example (Yablo 1999). The weight of an object depends on its local gravitational field. An object weighs less on the Moon than it does on the Earth (about one sixth as much). Hence intrinsic duplicates can have different weights depending on where they are. Or vulnerability—an object, person, or city may be vulnerable to attack but lose that vulnerability thanks to external protection. The Mona Lisa is invulnerable to attack by vandals because it is protected by plate

[26] This objection applies to (CA) but not to (RCA).

[27] Cf. Johnston (1992: 234) and Molnar (1999: 3).

glass, without which, although remaining intrinsically identical, it would be vulnerable.[28] In McKitrick's example a city may be protected against attack by a defence system located outside the city, perhaps controlled by a friendly foreign power.

One response McKitrick anticipates is that in these cases it is some intrinsic disposition that is doing the work. In the case of weight, it is the mass of the object that is responsible for its weight. (But it seems implausible that we can find an intrinsic property of the object itself responsible for its being vulnerable or invulnerable.) Quite rightly McKitrick responds that this is not relevant to her thesis, that some dispositions are not intrinsic. Even if true that in every case there is an underlying intrinsic disposition, that would not refute her claim that some 'superficial' ones are extrinsic.

A different, but related objection is that the dispositions McKitrick has discussed are not real properties, and hence not real dispositions in particular. That is to say they are not sparse or natural properties. Clearly some of her dispositions are not natural properties. In the case of weight, it is tempting to regard mass as the real and natural property. However, if we are to limit our discussion merely to sparse, natural properties we will find that we have excluded many of the paradigm dispositions that prompted our initial enquiry. For example, it is unclear that fragility is a sparse property. We would not expect to find that fragility is a property discussed in some perfect science; it is implausible that there is a universal of fragility. The current interest in the intrinsic dispositions thesis arises because our discussion of the analysis of disposition concepts may turn on that thesis.[29] And that discussion encompasses abundant as well as sparse dispositions. Nonetheless, it remains true that McKitrick has not yet refuted a restricted version of the thesis, which limits its scope to sparse properties.

Does then the falsity of the intrinsic dispositions thesis undermine the objections to the conditional analysis of dispositions, as McKitrick claims (2003: 155)? Consider the vase protected by the sorcerer (whether by fink or by antidote). An intrinsically identical unprotected vase is very fragile. Is the protected vase fragile too? We are tempted to say yes, and the objections get off the ground. But that temptation, it seems, may be motivated by the (erroneous) intrinsic dispositions thesis; it is because the vases are intrinsic duplicates that we ascribe fragility to the protected vase as well as the unprotected vase. If fragility is not intrinsic but depends also on environmental conditions (akin to weight), then perhaps, given the sorcerer's presence, the protected vase should not be regarded as fragile.

I think that this is too quick a rejection of the arguments against (CA). The ascription of fragility to the protected vase may be motivated by the intuitive plausibility of so doing in this particular case, rather than by a blanket adherence to the intrinsic dispositions thesis. After all it is natural to say that the sorcerer is concerned to protect his vase *because it is so fragile*. It seems to me that fragility and vulnerability are different. The sorcerer's protection renders the vase invulnerable to attack but does

[28] In 1956 the Mona Lisa was attacked with acid by a would-be modern Herostratus.

[29] Sungho Choi (2003*a*) argues in detail that my antidotes argument is much strengthened by the intrinsic dispositions thesis.

not affect its fragility. Even if vulnerability and certain other dispositions are extrinsic, fragility may well be intrinsic. At the very least, it is plausible, quite independently of the intrinsic dispositions thesis, that the sorcerer's vase is fragile—which is all we need.

Another way to see the unnaturalness of denying fragility to the protected vase is to consider that the protection may be granted *after* the striking has occurred. Consider two identical vases, named Ming and Meissen. Our question is whether they are fragile at time *t*. Before *t* the sorcerer has decided to protect one of them, but he has not yet chosen which. At *t* both Ming and Meissen are struck. With remarkable speed the sorcerer decides to protect Meissen and issues his protection (fink or antidote) soon enough for Meissen not to break. Meanwhile Ming does break. For Meissen not to be a counterexample to (CA), we have to say that at time *t* Ming is fragile and Meissen is not. But at *t* the environments of Ming and Meissen are the same. Thus Meissen's lack of fragility at *t* is dependent not so much on its environment at *t* but rather on what will occur later (the sorcerer's decision). That an object's fragility at some time should depend on events occurring at a later time is absurd, and so one may conclude that the finkish protection of vases it not a way of removing their fragility and hence that they do present a counterexample to (CA).

It might be responded that there must be some environmental difference at *t*, some asymmetry in the mind of the sorcerer that causes him to choose Meissen to protect. But that is to assume determinism. Perhaps at *t* the environment and the sorcerer are perfectly symmetrical with respect to the two vases (as in the case of Buridan's ass). What prompts the sorcerer to prefer to protect Meissen is the occurrence of some irreducibly probabilistic nuclear event occurring fractionally after *t*. Indeed we can drop the sorcerer altogether. As we saw, finkish dispositions can be acausal. So we may imagine a fragility-removing mechanism that is connected to a Schrödinger's-cat-style device, which is operative (coincidentally) from just after *t*, the moment of the vases' being struck. The decay of the radioactive nucleus causes the fragility-removing mechanism to work on Meissen but not on Ming. At *t* the two vases are in an entirely symmetrical position with respect to the rest of the world and its history; the symmetry is broken after the striking, permitting Ming to break but not Meissen. The symmetry at *t* shows that since Ming is fragile at *t* then so is Meissen.

I conclude therefore that the falsity of the intrinsic dispositions thesis is no reason to abandon the counterexamples to (CA). While the truth of the thesis would strongly support the arguments against (CA), the counterexamples can be motivated independently.

2.2.7 *Defending Lewis's Reformed Conditional Analysis?*

Let us now return to the discussion of Lewis's account. Can (RCA) be defended against my criticism? Any defence would have to show, contrary to what I have said, one of three things:

> (i) that the analysandum is not satisfied—it is false that *x* is disposed to M when S;

(ii) given that the analysandum is satisfied, that the antecedent in the analysans is not true—it is false that x undergoes stimulus S at time t and retains property B until time t');
(iii) given that the analysandum is satisfied, that the consequent in the analysans is true—it is true that S and x's having of B are jointly an x-complete cause of x's giving manifestation M.

I shall consider these in reverse order.

Response (iii) says that in the examples the stimulus and the causal basis are jointly a complete cause of the required response. Clearly this is not correct, since the required response does not occur, and so the stimulus and causal basis cannot be a cause of it. (I shall later consider a possible repair.)

Response (ii), denying the antecedent in the analysans, is tantamount to suggesting that the dispositions here are finkish, that their causal bases are lost during the time gap. The idea is that we should see the antidote as somehow changing the intrinsic nature of the object. The sorcerer's fink strategy and his antidote strategy for protecting the glass would not really be different in kind (in which case the antidote might be seen as a way of achieving the finkish removal of fragility).

The following might appear to support this response. A nuclear pile which is above critical mass has a disposition to melt down.[30] However, the pile has attached to it a fail-safe mechanism. Heat and radiation sensors detect large increases in radioactivity and allow boron moderating rods to penetrate the pile and by absorbing the radiation to prevent the meltdown.

One might call the fail-safe mechanism an antidote, but, so the response goes, it acts by removing the disposition to melt down. Once the boron rods are in place, there is (we hope) no possibility of meltdown. The disposition is removed, and this is achieved by changing the causal basis—the structure now consists not just of the fissile uranium-235 but also of boron. Hence the disposition is finkish. At best, this case just shows that the dividing line between finkishness and antidotes is not clearly perceptible, or that there is an overlap. Even so, I think there is a clear sense in which the explosive disposition is retained—it is not as if every U-235 atom has been changed into a non-fissile U-237 atom. The boron rods had still better be kept in place, the reason for which is that the disposition to melt down remains. It remains, but is held in check (which is a special case of an antidote). Holding a disposition in check does not eliminate it.

To see this case correctly it is important to be precise about what object the disposition in question belongs to. We can distinguish three combinations:

(a) the uranium pile alone;
(b) the uranium pile plus the boron rods;

[30] I haven't specified a stimulus. We can insert any appropriate stimulus that remains a constant factor, e.g. that the pile is maintained above critical mass. In correspondence David Lewis has suggested that the reactor is a boiling water reactor and that too much of the water has boiled off, so the disposition is the disposition to melt down in response to a loss of water.

> (c) the uranium pile plus the boron rods plus the fail-safe mechanism (i.e., the complete reactor).

These possess quite different dispositions. The uranium pile, (a), retains the disposition to melt down all the time. The combination of pile and boron rods, (b), does have a disposition to melt down when the rods are outside the pile, but loses this disposition when the rods are in the pile. Indeed, in the presence of the fail-safe mechanism (regarded as external to the pile-plus-rods), combination (b) with the rods out has its disposition to melt down finkishly. Whenever this combination is about to melt down, the fail-safe mechanism causes it to lose that disposition. The reactor as a whole, (c), i.e., including the fail-safe mechanism, as long as the mechanism is effective has no disposition to melt down at all.

Whichever way one may want to respond to the reactor case, which I have presented as one *prima facie* favourable to the objector, it seems perverse to describe the sorcerer's antidote for the struck glass as removing the disposition to shatter (or its causal basis). The normal causal process is being interfered with, but the interference does not remove the intrinsic properties which, in other cases, explain why a glass shatters. Another variant on the example should suffice. When a glass in normal circumstances is struck and shatters, it does so because fractures appear and spread until enough of them connect with one another for the glass to fall into pieces. If the sorcerer, acting very swiftly, follows each spreading fracture and repairs it a fraction of a second after it occurs, then although each of them occurs as it would in the normal case, the fractures do not all persist long enough for the glass to fall apart. We cannot say in this case that the causal basis of shattering has been removed, since the causal basis for shattering is the same as the causal basis for fracturing, and that, *ex hypothesi*, remains.

2.2.7.1 *Complex and abundant dispositions* Let us now turn to response (i). According to this response, the objects in question, which are protected by antidotes, do not have the dispositions I have ascribed to them. Thus the glass which the sorcerer protects by counteracting the striking is not disposed to break when struck. The uranium pile with the boron rods lowered is not disposed to melt down. This I understand to be Lewis's view of antidotes:

> We might offhand define a poison as a substance that is disposed to cause death if ingested. But that is rough: the specification both of the response and of the stimulus stand in need of various corrections. To take just one of the latter corrections: we should really say 'if ingested without its antidote'. Yet the need for this correction to the analysis of 'poison' teaches no lesson about the analysis of dispositionality in general. (Lewis 1997: 153)

There are two ways of reading this. First: '*x* is a (deadly) poison iff, if no antidote is taken, then *x* is disposed to kill when ingested' gives the analysis of '*x* is a poison', and Lewis's account gives the analysis of '*x* is disposed to kill'. Here the reference to the antidote is outside the scope of the characterization of the disposition ('disposed to kill when ingested').

Secondly: '*x* is a poison iff *x* is disposed to kill if no antidote is taken when ingested' gives the analysis of '*x* is a poison'. The difference between this and the first reading is that the rider 'if no antidote is taken' is now part of the specification of the stimulus (or perhaps the manifestation) and is within the scope of 'disposed to . . . '.

According to the first reading, whether or not a poison is disposed to kill is a conditional or relative matter. The poison is disposed to kill people who have not taken antidotes, but is not disposed to kill those who have. Nor is it disposed at time *t* to kill people who take the antidote after *t* (but soon enough to prevent death). And so, in general, *x*'s having a certain disposition at a time *t* may depend on (i) features extrinsic to *x*, and (ii) occurrences after *t*. In which case, dispositions cannot depend exclusively on intrinsic properties. This is inconsistent with Lewis's assertion that the possession of a disposition does concern only intrinsic properties. The refutation of the intrinsic dispositions thesis might seem to make a response such as this possible. But as the example of Ming and Meissen shows, we can construct cases of finkishness for dispositions that are unarguably intrinsic; we can likewise construct cases of antidotes for those dispositions that are intrinsic.

The second reading, which is the one Lewis intends, has the advantage over the first that it does not make the presence of the disposition dependent on the absence of the antidote. But it does mean that the characterization of the disposition is more complex than was at first suggested. The disposition a glass has is not a disposition to break when struck, but rather a disposition to break when struck if not later interfered with *à la* sorcerer. This means that the dispositions there are in the world are not the ones we think there are, because antidotes are almost always possible. A sugar cube is not disposed to dissolve in hot water; rather, we have to say that the sugar has the disposition to dissolve when placed in hot water while Maxwell's demon does not interfere with the molecular processes.

Even the latter is not satisfactory yet, because there may be all sorts of other antidotes to dissolving which have to be excluded in the analysans. We would therefore need to mention them too. But how could we know what all the possible antidotes to any given disposition are? It seems that we could not possibly properly characterize any real disposition.

Alternatively, we could exclude antidotes not explicitly, naming each one, but indirectly. So we would talk of something's being disposed to manifest M in response to stimulus S while nothing acts to prevent M. Or, better perhaps, we make no explicit exclusion by allowing the exclusion to be achieved by context. As David Lewis puts it, 'The sensible thing to do is to leave them [the possible antidotes] *un*mentioned, unless something about the context or our conversational purposes requires attention to them.'[31]

[31] Personal communication, 27 February 1998. Lewis continues,

> Rough specification of the dispositions we talk about is almost always good enough for practical purposes. In this, as in other matters, a demand for limitless precision is not just pointless but pernicious. The question what are the limits of permissible imprecision is a general question in pragmatics, to be answered (insofar as it can be answered) by common-sense

A possible objection is that this approach allows more dispositions in the world than many might be willing to admit. For we would have to admit the disposition of a glass to break in response to far-off sneezes. This is because there are some possible circumstances in which (via a butterfly effect) a sneeze brings about a major disturbance which, combined with the structure of the glass, causes it to shatter. Hence the sneeze and the glass's structure are a glass-complete cause of its shattering. Under normal circumstances this does not happen, but there is no reason why we should not regard normal circumstances as being circumstances which act to prevent the shattering from occurring. Another case is this. Cows' milk has the disposition to give human beings diarrhoea, because those who lack the enzyme lactase are unable to metabolize cows' milk and will suffer diarrhoea and other unpleasant symptoms. Ordinary people are lucky that the antidote lactase is present in their bodies. To put the point more generally, if an intrinsic property B of *x* were under some (nomically possible, but bizarre and unusual) circumstance to combine with an event E to cause outcome O, then we would have to admit that *x* has a disposition to manifest O in response to stimulus E. For whatever it is about normal circumstances which explains why B and E do not usually cause O will fall under the catch-all 'and nothing acts to prevent O'. Furthermore, it would seem that, since a state of affairs might have quite opposite effects depending on circumstances, something might simultaneously have what appear to be incompatible dispositions; for example milk seems to have both the disposition to nourish and the disposition to cause diarrhoea.

I used to find the multitude of dispositions objection compelling (Bird 1998: 231). But on reflection, there is no reason why we should not accept all sorts of dispositions. Above, in Section 2.1.1, I explained that we can talk of all sorts of properties, including the property of being grue, but this is when we are using 'property' in the abundant sense. Further work is required (by scientists, for example) to discover whether a certain abundant property is also a sparse or natural property. And what goes for properties in general goes for dispositions in particular. Not all dispositional locutions will correspond to natural properties or universals, and we should not expect the analysis of such locutions somehow to do the scientific work for us.

Nor need we worry too much about one object having opposing dispositions. That does not imply, for example, that milk will both nourish and cause diarrhoea in one and the same person. For the full specification of the stimulus conditions in each case would be different, and in particular in one case that specification would include the condition that lactase is present and in the other it would specify the absence of lactase.

I'll now summarize the position emerging from this response to antidotes: (i) We must recall the distinction between the covert/elliptical dispositional locutions and the overt/canonical locutions. Simple covert locutions do not necessarily or even typically have simple analyses into overt locutions. (ii) Were we to specify the overt locution, '$D_{(S,M)}$' equivalent to some covert locution, 'F', then S would list and require

considerations having to do with the purposes of conversationalists in this or that context. It is not something that needs to be built into the analysis of one word after another.

the absence of the antidotes to F. (iii) Consequently, the existence of antidotes does not provide a counterexample to (RCA), the analysis of overt locutions into counterfactuals. Rather they are counterexamples to simplistic analyses of covert into overt dispositional locutions. (iv) Many of the dispositions to which we intend to refer are complex, in that their full overt description would involve a lengthy specification of S (if we could supply it). (This may indeed be one reason why we do employ covert locutions, to stand in for complex overt ones.) (v) If, on the other hand, we do use overt locutions, we typically do so in a legitimately imprecise way, by not completely specifying S. That imprecision is legitimated by the pragmatics of the conversational context. (vi) There are many obscure and pointless dispositions. But that is no matter for concern, since they are not all natural properties.

2.2.8 *Repairs to the Conditional Analysis?*

The natural alternative is to seek some further repair to (CA) that adds to the first repair provided by Lewis in (RCA). Note from the discussion of the last subsection that there are two issues or steps in the process of analysis:

(a) the analysis of covert into overt dispositional locutions;
(b) the analysis of overt dispositional locutions into some kind of counterfactual.

Lewis locates the problem with finks at (b), which is why he provides a reformed conditional analysis. But he locates the problem of antidotes at (a), meaning that a precise analysis of a common covert locution, such as 'fragile', gets a complex analysis into an overt dispositional locution. Since it is complex, that dispositional locution will get a complex analysis into counterfactuals. But there will not be any added complexity (other than that required to deal with finks).

However, we could choose to locate the problem with antidotes at (b), along with the finks, rather than (a). Consequently, if there is to be any kind of analysis or explication of dispositions in terms of counterfactuals, it must do so by excluding antidotes in the counterfactual. For simplicity let us put finks on one side for the time being and return to the simple conditional analysis:

(CA) $\quad D_{(S,M)}x \leftrightarrow Sx \mathrel{\Box\!\!\rightarrow} Mx.$

Solving the problem of antidotes at (b) means that we need to add detail to the stimulus condition:

(CA$^+$) $\quad D_{(S,M)}x \leftrightarrow Sx\&Cx \mathrel{\Box\!\!\rightarrow} Mx.$

where Cx specifies the conditions that exclude antidotes.

The question then is how to exclude antidotes—that is, what should we say about C in (CA$^+$)? Imagine that we thought that a strictly accurate analysis of some disposition $D_{(\mathbf{S},\mathbf{M})}$ would include an explicit specification of those conditions (where **S** and **M** are not variables but denote specific properties). So:

(CA$^+_{(\mathbf{S},\mathbf{M})}$) $\quad D_{(\mathbf{S},\mathbf{M})}x \leftrightarrow \mathbf{S}x\&\mathbf{C}x \mathrel{\Box\!\!\rightarrow} \mathbf{M}x.$

where **C**x is a set of specific (antidote-excluding) conditions. But then what fixes the conditions **C**x? The left-hand side of (CA$^+_{(\mathbf{S},\mathbf{M})}$) mentions two properties, **S** and **M**, but

the right-hand side mentions a third, **C**. If this is to be an analysis, the right-hand side had better not be underdetermined, i.e. something must exclude:

$(\mathrm{CA}^{+}_{(\mathbf{S},\mathbf{M})})'$ $\quad \mathrm{D}_{(\mathbf{S},\mathbf{M})}x \leftrightarrow \mathbf{S}x\&\mathbf{C}'x \mathrel{\Box\!\!\rightarrow} \mathbf{M}x.$

(where $\mathbf{C}\neq\mathbf{C}'$) from being correct.

Conceivably, for some common pairs of specific **S** and **M**, **C** is fixed by usage. But since we would want '$\mathrm{D}_{(\mathrm{S,M})}$' to denote a determinate property for a large range of properties S and M, we should expect, for the general case, there to be a function from S and M to C. So we may write:

(CA^{+}) $\quad \mathrm{D}_{(\mathrm{S,M})}x \leftrightarrow \mathrm{S}x\&\mathrm{F}_{(\mathrm{S,M})}x \mathrel{\Box\!\!\rightarrow} \mathrm{M}x.$

where F is the function referred to. We now need to know what F is.

The simplest proposal notes that antidotes work by the action of something that prevents M from occurring. So F would fix C negatively, so that C is the absence of conditions that prevent M.[32] I.e.

$\mathrm{F}_{(\mathrm{S,M})}$ ↔ no condition exists that would prevent M from occurring.

The obvious objection is that the right-hand side of (CA^{+}) now reduces to triviality, if we take to be a condition that prevents M any condition in which M does not occur. In which case the absence of such a preventing condition is precisely one in which M occurs, and hence the counterfactual on the right-hand side is trivially true.

We might try to save a version of (CA^{+}) by one or other of two routes. First, we might take 'prevent' to be a more robust notion, so the circumstances excluded are those that would *cause* M not to occur. Secondly, we might now make use of the richer machinery of Lewis's (RCA). If we adopt both we have (addition to (RCA) underlined):

(RCA^{+}) Something x is disposed at time t to give manifest M to stimulus S iff
for some intrinsic property B that x has at time t and for some time t' after t, if x were to undergo stimulus S and retain B until time t', <u>and nothing extrinsic to x and S were to act to prevent S and B causing M</u>, then S and B would jointly be an x-complete cause of x's manifesting M.

Even so, this does not do the trick for several reasons. First, we may not want too robust a notion of prevention since some antidotes might themselves be absences rather than active agents. For example, removal of oxygen from the air might be an antidote to inflammability. Perhaps we should allow causation by absences. But it seems that the difference between causation by an absence and mere failure to occur is contextual or relative to normal circumstances (of which more in a moment).

Secondly, Martin objects that the notion of prevention is itself question-beggingly dispositional (Martin 1994: 5-6; Martin and Heil 1998). Perhaps prevention is causal, as proposed—A prevents B from occurring = A causes B not to occur—but in any case Martin thinks that *disposition* is a more fundamental notion than *cause* (Armstrong *et al.* 1996: 81, 136). (Of course, if that is right, then Lewis has from the very start erred in seeking a causal analysis, in a traditional, conceptual sense, of disposition terms.)

[32] Something like this is suggested in Johnston (1992).

That might be a disadvantage to me also, since I want to give a dispositional account of laws and consequently causes. However, my account of laws is not intended to be a conceptual analysis but a substantive metaphysical thesis. In which case the appearance of modal concepts such as 'cause' in the analysis of 'disposition' may not be so worrying.

Thirdly, even if (RCA$^+$) avoids the extreme triviality of which (CA$^+$) is accused, it still comes close. An intrinsic property B may under some circumstances C combine with S to be an *x*-complete cause of M. So we may regard all other circumstances, C, as preventing B and S from causing M. Hence *x* is disposed to manifest M in response to stimulus S. But for many such properties B and stimuli S there will be such circumstances C′, even if rare or bizarre, under which B and S cause M, as in the example of a glass which is caused to break by a sneeze and its intrinsic structure, thanks to the unlikely intervening chaotic events.

A second species of approach takes F to specify *normal* conditions or *ideal* conditions or some *ceteris paribus* condition. Mumford's (1998: 88) 'conditional conditional' view is an instance this. Here we have two, nested subjunctive conditionals: <C□→(S□→M)>, where C specifies that conditions are ideal. Note that this nested conditional conditional is not equivalent to a single conditional with a conjunctive antecedent: <S&C□→M>, which is the analysis in (CA$^+$). It is not clear to me why Mumford prefers the former. Indeed, there is a problem with Mumford's conditional conditional. Roughly speaking <C□→(S□→M)> is true, at the actual world, $w_@$, if in the nearest world where C, <S□→M> is true. Call that world w_1. So what makes <S□→M> true at w_1? That at the nearest world to w_1 where S, M is also true. Call that w_2. The ideal conditions, C, are such that they rule out the finkish disappearance of the disposition in response to S (i.e. the transition from w_1 to w_2). But that does not rule out the disappearance of the disposition in the transition from $w_@$ to w_1. Suppose that conditions are not ideal and we do have a disposition; but in the nearest world where conditions are ideal, we don't have the disposition. Mithradates has ingested an antidote to all poisons. So conditions are not ideal for the exercise of the poisonous disposition of his birthday dinner. But were conditions ideal, i.e. Mithradates has not taken the universal antidote, Mithradates would ensure that his meal is treated with the universal poison-remover. That is, Mumford's conditional conditional just pushes back the problem of finkishess—the finkish removal of the disposition is not brought about by the dispsoition's stimulus but by the presence of ideal conditions.

So it look as if sticking with the form in (CA$^+$), with a conjunctive antecedent, is advisable. Nonetheless, the problem of providing a way of specifying C when given S and M (i.e. isolating the function $F_{(S,M)}$) remains, and has so far found no satisfactory solution.

2.2.9 *The Conditional Analysis revisited*

I presented both finks and antidotes as objections to the simple conditional analysis of dispositions, (CA). Lewis's response was to regard finks as genuine objections to (CA), hence motivating his repair, (RCA) (that is, finks are dealt with at step (b) in

Section 2.2.8). But he rejects antidotes as an objection to (CA) or (RCA) and instead regards them as counterexamples to simplistic analyses of covert into overt dispositional locutions (i.e. antidotes are dealt with at step (a)). This suggests that a third position would regard neither finks nor antidotes as objections to (CA) but instead regard them *both* as objections to a simplistic analysis of covert into overt dispositional locutions (i.e. both finks and antidotes are dealt with at step (a)). This is the view taken by Sungho Choi (2003*b*).[33] According to the approach taken by Choi, the vase is fragile; but it is not disposed to break when struck. Rather the proper analysis of fragility will include specifying a stimulus that includes both the stressing and the absence of finks and antidotes. We have mentioned the unsolved problem of specifying the absence of finks and antidotes in a general yet non-trivial way. But *this* approach has another option, which is to specify them directly. Because we are analysing fragility, not the disposition to break when stressed, we are at liberty to spell out the additional conditions in a way that is not a function simply of stressing and breaking. Thus we say that arsenic is poisonous, but deny that arsenic has the disposition to kill when ingested. Rather arsenic has the disposition to kill when ingested by someone who has not or will not soon take dimercaprol—that is part of the way towards the analysis of being poisonous. To have a disposition that suffers from no finks or antidotes we would require a disposition of the form: the disposition to yield M in response to (S in the absence of $A_1, A_2, A_3, \ldots$), where $\{A_1, A_2, A_3, \ldots\}$ is the set that includes every possible fink or antidote to the covert disposition (e.g. fragility or being poisonous, etc.) that we have in mind. (I'll confine myself to antidotes in what follows.)

This approach has several problems. I shall consider the two most serious. First, it is widely accepted that a disposition might be realized by a variety of different causal bases. So a lot of different substances might be poisonous and poisonous for different reasons. Some might be neurotoxins, some might interfere with a crucial metabolic pathway or cause a malfunction in any of the body's vital organs. And a poison might do any one of these things in a wide variety of different ways. Consequently, although dimercaprol is an antidote to poisoning by arsenic or by another heavy metal, it is not an antidote to most other poisons. Now let us consider the disposition $D_{I^*,K}$ where I* is ingesting in the absence of $A_1, A_2, A_3, \ldots$, and K is killing. $D_{I^*,K}$ is thus disposition to kill when ingested in the absence of any antidote to any poison. Does this satisfactorily analyse *being poisonous*? No it does not. Consider someone who has taken a large dose of dimercaprol, but is then bitten by a coral snake or cobra with a neurotoxic venom. It is clear that the snake venom is poisonous and will kill the unfortunate victim, despite the dimercaprol, which has no effect on neurotoxins. So the subsequent death of the victim may certainly be explained by reference to the fact that the venom is poisonous. On the other hand the death cannot be explained by reference to $D_{I^*,K}$. For although the venom does possess $D_{I^*,K}$ (it is disposed to kill those who have the snake bite but have no antidote to any poison), it cannot explain

[33] I note that Lars Gundersen (2002) also defends (CA), by rejecting the Lewis–Stalnaker semantics for subjunctive conditionals.

anything in this case, since the relevant stimulus condition, ingesting without any of $A_1, A_2, A_3, \ldots$, is not met—the subject has taken dimercaprol.

So, a covert disposition that may be multiply realized cannot be replaced without loss by an analysis as an overt disposition with the absence of antidotes specified. The second reason for not wanting to make this replacement is the oft-cited fact that the replacement is just not possible. It is not possible because it is not possible to know what all the antidotes are. This objection needs to be handled with care, since it is an epistemic objection to a metaphysical proposal. The metaphysical proposal we are considering is, in effect, that whenever there is an antidote-sensitive disposition, there is always an antidote-free disposition. The response of the preceding paragraph shows that the complex overt, antidote-proofed disposition will be less explanatorily powerful than the covert disposition; which suggests that it is a less respectable natural or sparse property. This conclusion is reinforced by the epistemic consideration. The unknowability of the set $\{A_1, A_2, A_3, \ldots\}$ suggests that it is not a natural set—there is no unifying factor, other than being the set of all possible antidotes to D. Correspondingly, the property (being A_1 or being A_2 or being A_3 or ...) is not a natural property, and so the stimulus condition (S in the absence of A_1, A_2, A_3, ...) is not a natural property either. In which case the disposition $D_{I^*,K}$ will also not be a natural property. [34]

Armstrong holds the view that multiple realizability does not really occur and that for each realizer there is a distinct disposition. This would ameliorate the first problem mentioned, but it would still permit the second to be raised. On this view there is no property of being poisonous, but only distinct properties of being a neurotoxin, being a-poison-that-attacks-the-kidneys and so forth. But even if we restrict our attention to any one of these, the conditions required for the poison to operate, even if entirely normal and to be expected, may be complex. There may thus be a large number of ways in which an antidote might operate, and it might well be very difficult or even impossible to identify them all.

Furthermore, the identification of all the antidotes would require knowledge of the mechanism by which the disposition operates, which will be at a deeper level. Thus identification of $D_{I^*,K}$ will typically require knowledge of a deeper level of science than is required to understand what it is to be poisonous. Those who favour eliminativism might favour the view that $D_{I^*,K}$ should supersede *being poisonous* scientifically, replacing it in an improved science. But those who resist eliminativism elsewhere will prefer to conclude that the success of higher-level science shows that it does identify genuine natural properties, even if there is no reduction of these to lower-level properties that does just as well.

[34] While many covert dispositions will not be natural properties, many others will be. I surmise that a covert disposition name, when a name of a natural property, acquires its reference not by having a sense equivalent to some overt dispositional expression, but rather by means of a causal relation with the natural property itself, or by some combination of causal and descriptive mechanisms. In which case one would not expect a complete overt analysis to be available by *a priori* means. Nor indeed should one expect an analysis by *a posteriori* means necessarily to be available either.

The conclusion that we should draw is that if we think that a non-fundamental covertly identified disposition is an explanatorily efficacious natural property, then we have no reason to regard it as analysable as a complex, overtly specified disposition with antidotes explicitly excluded. On the contrary the latter would be scientifically less respectable and less likely to be a genuine natural property. In some cases we may be willing to adopt the eliminativist view—plausibly there is no natural property of being poisonous, and that scientific toxicology would have no explanatory need of such a concept as opposed to the more specific ways of being poisonous. On the other hand when it comes to mental dispositions we are more inclined to take the properties to be natural and explanatorily essential. In which case there is no analysis for those dispositions in overt, antidote-resistant terms.

2.3 Conclusion

In the next chapter I will further expound the central claim of this book, that all the fundamental natural properties have dispositional essences—a claim that may also be expressed by saying that fundamental natural properties are dispositions, and are essentially so. I started this chapter by outlining the case for a distinction between natural and non-natural properties—or, in Lewis's terms, between sparse and (merely) abundant properties. The distinction is significant because it needs a corresponding ontological distinction. Natural properties, or at least the fundamental ones, perform important roles that non-natural properties cannot. The two principal roles are (i) marking objective differences between things (and hence allowing us to distinguish intrinsic from extrinsic qualities), and (ii) explaining causal and nomic interaction. It is easiest to see matters in terms of a three-way distinction between (a) fundamental natural properties, (b) non-fundamental natural properties, and (c) non-natural properties. It is an interesting question where exactly the ontological division falls—between (a) and (b) or between (b) and (c). The latter would allow for a precise correspondence between the ontological difference claim and the natural versus non-natural distinction. The former breaks the precise correspondence and would allow for a graduated natural versus non-natural distinction. Either way, there is an ontological difference between (a) and (c), which is sufficient for understanding the central claim concerning fundamental natural properties. I propose that the ontological difference is one between properties that are universals and those that are not. In an inventory of the basic stuff of the universe we will find universals and hence the fundamental natural properties, but we won't find any entity that is the property of being grue. (It is not especially important for my view that it has to be universals, rather than tropes, for example, that do the ontological work. When considering the laws of nature, the unity provided by universals seems most plausible, and so it is the terminology that I will henceforth use; but those who prefer a different ontology are invited to make suitable substitutions.)

Understanding the remainder of the central claim, that the fundamental natural properties have *dispositional* essences, requires gaining some familiarity with the concept of disposition and some of the philosophical issues it raises. That was the task of the remainder of the chapter. The obvious place to start was the simple sub-

junctive conditional analysis, (CA). But that analysis suffers from the counterexamples of finks and antidotes. And the evidence suggests that the conditional analysis of dispositions cannot be saved from the counterexamples; nor can it be easily repaired. But even if we were to retain (CA), that would be at the cost of moving the trouble of finks and antidotes to the relationship between covert and overt dispositions. That is significant, because it is plausible to think that the covert dispositions are the ones we are especially interested in. They are the ones to which we have given a name rather than relying on a locution of the form 'the disposition to M when S'.

Not all covert dispositions will correspond to natural (sparse) properties. For example, it is debatable where 'fragility' names a natural property, because fragility can be realized in a multiplicity of different ways. However, our special interest in them suggests that some may be (charge, mass). Consequently, the analysis of such covert, natural dispositions into a simple subjunctive conditional may be expected to be beset by problems of finks and antidotes. It is unclear, however, whether the most basic natural disposition must suffer from finks and antidotes, and this is a question I address in Section 3.3 of the next chapter.

3

DISPOSITIONAL ESSENTIALISM AND THE LAWS OF NATURE

In this chapter I articulate the position known as *dispositional essentialism*. This is a view about the nature of properties—or, as far as I am concerned, principally about *fundamental* natural properties and possibly others besides. This view, which finds early expression in the view of properties discussed by Sidney Shoemaker (1980) and developed by Brian Ellis and Caroline Lierse (Ellis and Lierse 1994), says that the relevant properties have essences that are dispositional in character.[35] The defence of this view must await the next chapter. The purpose of this chapter is to show how it may account for the laws of nature, expanding on a proposal by Chris Swoyer (1982). The view has been more recently articulated and defended by Simon Bostock (2001) as well as Ellis (2001) (cf. Ellis (2002) and Bird (2005*a*)). If properties have a dispositional essence then certain relations will hold of necessity between the relevant universals; these relations we may identify with the laws of nature. The necessity here is metaphysical. In Section 3.3 I show that this account of laws can be extended in a natural way to *ceteris paribus* laws. Since the relevant relations hold necessarily, this view is committed to necessitarianism about laws—laws are metaphysically necessary. I defend necessitarianism in Chapter 8. In this chapter, I explore the nature of the claim that laws are necessary. A weaker version of the claim holds that the necessity of laws is a restricted metaphysical necessity—a law holds in all possible worlds where the relevant universal exists. In Section 3.2 I consider the stronger view that the laws hold and the universals exist in all possible worlds without exception.

3.1 How dispositional essentialism accounts for the laws of nature

3.1.1 *Dispositional essentialism and potencies*

In the preceding chapter I discussed the nature of certain locutions relating to the ascription of properties and qualities to things. We examined the conditional analysis of dispositions:

(CA) $\quad D_{(S,M)}x \leftrightarrow Sx \mathrel{\Box\!\!\rightarrow} Mx,$

where '$D_{(S,M)}$' symbolizes 'x is disposed to manifest M in response to stimulus S, and '$\Box\!\!\rightarrow$' symbolizes the subjunctive/counterfactual conditional.

As its name suggests (CA) is intended to be an analysis of the relevant dispositional locutions. I do not make this claim myself, although if (CA) is true, it is plausible that it is analytically true. Instead I shall take (CA) as a necessary equivalence (which would be the case if it is analytically true), and so we can write:

($CA_{\Box}$) $\quad \Box(D_{(S,M)}x \leftrightarrow Sx \mathrel{\Box\!\!\rightarrow} Mx).$

[35] See also Harré and Madden (1975) for an early anti-Humean metaphysics of causal powers.

As we have seen, there are reasons, in the form of finks and antidotes, to believe that (CA) is false. But, I will argue in Section 3.3, that fact turns out to be an advantage because the respect in which (CA) is false allows us to account for *ceteris paribus* laws. Even so, it remains a useful approximation for many purposes, and I shall assume its truth until we come to discuss *ceteris paribus* laws.

Having discussed dispositional locutions, I now want to turn to the properties themselves. The view of properties that I am promoting in this book is known as *dispositional essentialism*. Dispositional essentialism, when applied to a particular property, says that that property has a *dispositional essence*.[36] A contrasting claim is that the property is *categorical*. Understanding this distinction is important. Essentially dispositional properties are ones that have the same dispositional character in all possible worlds; that character is the property's *real* rather than merely nominal essence. Categorical properties, on the other hand, do not have their dispositional characters modally fixed, but may change their dispositional characters (and their causal and nomic behaviour more generally) across different worlds. The differences in character are consequences of the different laws of nature in each world. Categoricalism about properties goes hand in hand with the view that the laws of nature are contingent and tell the properties what to do (or describe the patterns of regularity they happen to be parts of). Essentially dispositional properties have their identities fixed by their dispositional characters; categorical properties have primitive identity. Clearly no property may be categorical and have a dispositional essence at the same time. The distinction between categorical and essentially dispositional properties is a modal and hence metaphysical distinction. This contrasts with the view that the dispositional/categorical distinction is really only a distinction between predicates, and not a distinction between properties (Mumford 1998; Martin (Armstrong *et al.* 1996); Lowe 2006).[37] I agree that there is *also* a distinction among predicates. In the latter case the issue is whether the *nominal* essence of the predicate *terms* implies a dispositional predication, i.e. one that can be expressed using an overt dispositional predicate of the form discussed in Section 2.2. But since I hold that there is a metaphysical distinction also, I cannot agree with Martin or Heil (2003: 112) that as regards properties they have both a dispositional and a categorical side or aspect. Properties may be one or the other but not both.[38] Note that I do not hold that the distinction as applied to predicates matches the distinction as applied to properties. A non-dispositional predicate may refer to an essentially dispositional property: '. . . has that property which is my favourite natural property' is a non-dispositional predicate that denotes electric charge, which is, if my theory is correct, essentially dispositional.[39] Likewise, if Armstrong is correct all properties are categorical. But a dispositional predicate may denote such a property; the dispositional predicate denotes the cat-

[36] Cf. Ellis and Lierse (1994) for dispositional essentialism. They adopt the mixed view (MV)—see below.

[37] I do not think that this is Mumford's current view.

[38] This is on the definition of a categorical property as one which has no dispositional essence. However, if one chooses to define a categorical property positively, as one which has a quiddity, then in principle a categorical property may have dispositional essence; cf. Section 4.2.1 and footnote 72.

[39] But see Section 2.2.1 for a qualification.

egorical property in virtue of the dispositional role it happens, contingently, to play in this world. We therefore need to keep the dispositional–categorial distinction as applied to predicates separate from that distinction as applied to properties. (I shall return to this in more detail in Section 7.1.2.1.)

Clearly, one can understand the distinction between properties without thinking that both sides of the distinction are in fact represented, just as one can understand the distinction between witches and non-witches without thinking that there are any witches. Given these two ways of understanding properties we have three possible positions with regard to all those sparse, natural properties that appear in the fundamental laws of nature: dispositional monism (DM); categorical monism (CM); and a mixed view (MV). I.e.:

(DM) All sparse, fundamental properties have dispositional essences.
(CM) All sparse, fundamental properties are categorical.
(MV) Some sparse, fundamental properties have dispositional essences and others are categorical.

To say that a property has a dispositional essence or is essentially dispositional is to say first that that property has some essence that may be characterized dispositionally. (I shall examine categorical properties in the next chapter.) Properties with dispositional essences I shall call *potencies*.[40] (DM) is the claim that potencies exist and that the fundamental natural properties are potencies. Some philosophers, such as David Armstrong, deny that potencies exist. We shall examine his arguments in later chapters. (DM) and (MV) share a commitment to the existence of some potencies. That shared commitment may serve to define dispositional essentialism:

(DE) At least some sparse, fundamental properties have dispositional essences.

The essences of potencies are *real* essences, which is to say they concern the nature of the property in question and are not merely reflections of the meanings of the corresponding terms. Thus, according to dispositional essentialism, the real essence of some potency P includes a disposition to give some particular characteristic manifestation M in response to a characteristic stimulus S. Hence, in all possible worlds, any object that possesses P is disposed to yield M in response to S:

$(\mathrm{DE_P}) \quad \Box(\mathrm{P}x \rightarrow \mathrm{D}_{(\mathrm{S,M})}x)$.

So, for example, the property that is negative charge may be attributed a dispositional essence. That essence would be the disposition to repel other negative charges and attract positive ones.[41] (I have said that dispositional essentialism says that some

[40] George Molnar (2003) calls them *powers*. I prefer to introduce a new term to fill this specific role, rather than employ a term that already has a use. I similarly avoid the term 'disposition', as used by Prior (1982), to name essentially dispositional properties. It is common to say that conductivity is a disposition or that electrically charged objects have the power to repel or attract other electrically charged objects. One ought to be able to say such things without appearing to beg the question of whether the properties thereby referred to have dispositional essences or not. Hence the need for a technical term for a property with a dispositional essence.

[41] Some dispositions will have stimuli that are typically or even necessarily always present. Typically two charges will always influence one another, if only slightly, even if they are very far apart. However, charges

properties, potencies, have dispositional essences. It is a further claim that the individuation of potencies is to be given by their dispositional powers. If this claim, which I accept, is added then the conditional in (DE_P) can be replaced by a biconditional—in effect maintaining that potencies just are their dispositional powers. That difference will not affect what follows. I shall return to this issue in the next chapter.)

3.1.2 *Deriving the laws of nature from dispositional essentialism*

Dispositional essentialism is a view about the real essences of certain natural properties. It permits a view about the nature of laws. On this view laws reflect the essences of properties. Since both (DM) and (MV) accept the existence of potencies, both views can avail themselves of this account of laws. For the moment we can say that this is true of at least *some* laws. Whether we can extend this to account for *all* laws we shall see shortly. Let us see how we get this result. Let P be a potency, i.e. some property with a dispositional essence, as in (DE_P) above. Combine (DE_P) with ($CA_\Box$) and we have:

(I) $\Box(Px \rightarrow (Sx \,\Box\!\!\rightarrow Mx))$.

Now consider any world w and any case where some x in w possesses the potency P. Let x acquire the stimulus S, i.e.

(II) $Px \,\&\, Sx$.

By (I) and (II) we have:

(III) Mx.

Discharging (II) we have:

(IV) $(Px \,\&\, Sx) \rightarrow Mx$.

Since x is arbitrary we may generalize:

(V) $\forall x((Px \,\&\, Sx) \rightarrow Mx)$.

We thus have a universal generalization derived from a claim about the essence of P, (DE_P), plus the general necessary truth, ($CA_\Box$). Hence we have explained the truth of a generalization on the basis of the dispositional essence of a property. This is the core of the dispositional essentialist explanation of laws. Since the generalization is non-accidental it is a nomic generalization.

What then are the laws of nature, according to the dispositional essentialist account? One way to proceed would be to assimilate as far as possible what is correct in the common alternative views of laws—the regularity view and the relation-among-universals view—to dispositional essentialism.

On one view of what laws are, (V) itself states a law of nature. This view would agree with Lewis that laws are regularities but disagree with Lewis very deeply about what makes one regularity a law and not another. On Lewis's view it is the fact that the regularity is a consequence of the optimal systematization of all particular facts. According to the regularity version of dispositional essentialism about laws, laws are

can be electrically isolated from one another. So in this case, the appropriate stimulus will be a matter of the charges not being electrically isolated from one another.

those regularities whose truth is guaranteed by the essentially dispositional nature of one or more of the constituent properties, in the way that the truth of (V) is guaranteed by the dispositional nature of P. Regularities that supervene on such laws will also be laws.

A different view is that the law in this case is a certain kind of relation among universals. In the above case it is a relation between the universals P, S, and M. David Armstrong also holds that laws are a relation among universals, and the current version of dispositional essentialism about laws would agree with Armstrong in large measure. However, there is a crucial difference. Armstrong regards his relation among universals, which he calls 'necessitation', as a contingent relation among universals.[42] Armstrong's relation is a *sui generis* relation.[43] The dispositional essentialist, by contrast, takes the relation to be one of metaphysical necessitation. Armstrong used the symbol 'N' for necessitation, so a law for Armstrong would have the form N(F,G). Let us use 'N' for the relation between universals, as conceived of by the dispositional essentialist. While N is *sui generis*, we may hope to analyse N. The simplest analysis would be: N(F,G) iff $\Box(\forall x(Fx \rightarrow Gx))$ (where 'F' and 'G' are names of universals). But this clearly is a simplification, for it will allow too many entailment relations to be regarded as nomological. It might therefore be appropriate to restrict use of 'N' to those instances of '$\Box$' that arise from the essence of some property in the manner just described. Thus we have N(P&S,M) in the case discussed, since it holds as a deductive consequence of the essentially dispositional nature of P (viz. $D_{(S,M)}$). Two of the criticisms levelled at Armstrong are that it is unclear what his relation of contingent necessitation is and that it is unclear how it is able to necessitate anything. Clearly these problems do not arise in this case. (I shall return to criticisms of Armstrong in detail in the next chapter.)

I note that while Armstrong's N is intended to be a universal, there is no reason to regard the dispositional essentialist's 'N' as denoting a universal, since there is no reason to suppose that there is a universal holding between F and G under precisely the conditions specified in the analysis of N(F,G). The dispositional essentialist can be reasonably relaxed as regards the question, 'what exactly are the laws of nature?', for two reasons. First, whatever one takes laws to be, the derivation of (V) and so N(P&S,M) from (CA) & (DE_P) shows that dispositional essentialism can account for at least some of the laws of nature. Secondly, the dispositional essentialist view will regard the motor and cement of the universe as residing ultimately not in the laws themselves but rather in the dispositional nature of properties. The laws are, in a sense, epiphenomenal. I shall return in Chapter 9 to the question of what, more precisely, the laws of nature are.

As should be already clear, and as I shall discuss in detail in the next section, the laws of nature are, according to the dispositional essentialist view, metaphysically necessary. We have conflicting intuitions about laws. We think that they are contin-

[42] However, one should note also Evan Fales's (1990) proposal, which is somewhat like Armstrong's except that the necessitation relation is taken to be metaphysical necessitation.

[43] In Michael Tooley's (1977) version of the same necessitation account of laws, there is a family of such relations. That family is *sui generis*.

gent, since we can imagine them being otherwise; on the other hand we recognize that laws are responsible for making things happen—their antecedents necessitate their consequents. Armstrong's N is an attempt to satisfy both sides of this tension, but as we shall see in Section 4.4 he cannot do so without also importing full metaphysical necessity. Lewis on the other hand rejects the necessity aspect of laws almost altogether. I say 'almost' because there is a residual necessity in that Lewis takes similarity of laws to be a significant factor in determining the nearness of possible worlds. In my view there is nothing in his fundamental, Humean outlook that licenses this; the role of laws in the similarity of worlds is simply to make Lewis's analysis of counterfactuals come out correctly.[44] Dispositional essentialism decides the issue in the opposite direction, coming down firmly on the side of necessity. I regard it as an advantage of my view that it identifies nomic necessity with metaphysical necessity. We don't need a multiplicity of necessities, we need just one. (I should mention that I do not regard logical necessity as a kind of necessity. A logically necessary truth is one that remains true for all syntactically permissible systematic substitutions of non-logical vocabulary. If we take '=' to be a logical symbol, then 'George Orwell = George Orwell' is a logical truth, but 'George Orwell = Eric Blair' is not. Thus it is logically possible that George Orwell is not Eric Blair. But in what sense is this any kind of possibility? The logical possibility arises from the fact that one object has two names. But that confers no genuine possibility on 'George Orwell ≠ Eric Blair', which is no more possible than 'George Orwell ≠ George Orwell'. Nor does it add to the kinds of possibility and necessity that one may define new modal terms along the lines of: p is nomologically possible iff ($p \wedge$ the laws of nature) is metaphysically possible, and p is nomologically necessary iff (the laws of nature $\rightarrow p$) is metaphysically necessary. But that is clearly a constructed kind, and the trick of construction can be pulled for anything whatsoever, e.g. 'feline necessity', where something is felinely necessary if it is true in all possible worlds which contain cats. Neither nomological necessity nor feline necessity name a distinct and genuine kind of necessity.)

3.1.3 *The laws of nature are necessary*

Since (V) holds in an arbitrary world w it is necessary:

$(V_{\Box})$ $\quad \Box\forall x((Px \,\&\, Sx) \rightarrow Mx)$.

And so dispositional essentialism, (DE), has the following consequence, partial necessitarianism about laws:

(PNL) At least some of the laws of nature are metaphysically necessary.

An ambitious dispositional essentialist may wish to go beyond partial necessitarianism to full necessitarianism:

(FNL) All the laws of nature are metaphysically necessary.

The fact that (DE) can explain some of the laws of nature inspires the thought that it might explain them all. Accepting (PNL) but not (FNL) would give us a mixed view of laws, some explained as consequences of (DE) while others are explained *à*

[44] See Bird (2007) for a discussion of this point.

la façon de Lewis or *à la façon d'*Armstrong. This would seem to be an untidy metaphysic, with two classes of laws.[45] Theorists have always sought a unified account of laws. If we accept:

> (U) Whatever it is, the true account of fundamental laws is a unified account,

then a commitment to (PNL) becomes a commitment to (FNL).

We need to give consideration to the exact scope of import of the □ in ($V_{\Box}$). There are two possible views here. The weaker, more conservative view holds that laws are necessary in a sense similar to Kripke's necessity of identity. The claim □(Eric Blair = George Orwell) is consistent with there being possible worlds where Blair/Orwell does not exist.[46] The corresponding view for the necessity of laws is this. Laws concern universals (i.e. sparse, natural properties). Universals may or may not exist in different possible worlds. The conservative necessitarian will say that the law L(P) concerning universal P is necessary, and that this requires only that L(P) holds in all possible worlds where P exists. Just as worlds where Eric Blair was never born are not counterexamples to the claim □(Eric Blair = George Orwell), worlds where P does not exist are not counterexamples to the claim □L(P). What □(Eric Blair = George Orwell) rules out are worlds where Eric Blair and George Orwell exist but are distinct individuals. What □L(P) rules out are worlds where P exists but is not governed by the law L(P) (worlds where P exists but is governed by other laws or by no laws at all). Thus □L(P) is consistent with there being worlds in which L(P) is not a law. It is also consistent with there being worlds where there exist properties Q, R, etc. that do not exist in our world. In a world where Q and R exist, they may be governed by laws L*(Q) and L†(R) that are not laws of our world. Of course □L*(Q) and □L†(R) will also be true in just the way that □L(P) is true. But on this weak version of the necessitarian claim about laws, it is possible both that □L*(Q) and that there is no law L*(Q) in the actual world. On this view possible worlds are nomologically consistent with one another. No world contains any fact that is a counterexample to a law that holds in any other world. But worlds may be nomologically distinct in that a law that exists in one world may not exist in another world.

The more radical necessitarian view of laws requires more than is provided for by the analogy with identity. According to strong necessitarianism laws of nature are necessary (in the sense explained above) and furthermore in each possible world all

[45] In addition to its inherent inelegance a further reason to reject the mixed position is that some other account of the laws not accounted for by (DE) must be found. But since I argue that the alternatives are flawed (see Sections 4.3 and 4.4), a mixed account must be flawed. Note that a mixed account of laws is *not* the same as a mixed view (MV) of properties. The latter can side with a unified necessitarian (dispositional essentialist) account of laws.

[46] This is true whether one prefers the view that '□(Eric Blair = George Orwell)' is true because 'Eric Blair' and 'George Orwell' denote the same individual at all possible worlds where Blair or Orwell exists, or the Kaplan view that the proposition 'Eric Blair = George Orwell' asserts of some actual individual (Blair/Orwell) that he is identical with himself, a proposition whose truth value is insensitive to changes in the possible worlds at which it is evaluated, and so is true even of worlds where Blair/Orwell does not exist (because, to use Kaplan's imagery, Blair/Orwell is loaded into the proposition, before it makes its round-the-worlds journey) (Kaplan 1989: 569).

laws hold, and so the properties they involve exist. Let us distinguish between the truth *of* a law proposition at a world and the holding of a law *at* that world. This would match the distinction between the truth of a proposition such as the proposition that Blair is Orwell and the fact of Blair's existence and identity with Orwell. Arguably the proposition can be true of a world where the fact does not exist.[47] So the weak necessitarian view of laws expressed in the preceding paragraph is this:

(WN) $L(P) \rightarrow \forall w$(it is true of w that L(P));

while strong necessitarianism is as follows:

(SN) $L(P) \rightarrow \forall w$(L(P) holds at w),

where:

(LH) L(P) holds (exists) at w iff it is true of w that L(P) and P exists at w.[48]

Let us reserve '$\Box$' for the weak necessitarian view, while '$\Box^+$' abbreviates the strong necessitarian view. Let L*(Q) be a possible law, i.e. $\Diamond$L*(Q). Let then w^* be a world where L*(Q). According to strong necessitarianism, in w^*, $\Box^+$L*(Q); and so $\Diamond\Box^+$L*(Q) is true of the actual world. By S5, $\Box^+$L*(Q). And so we have: $\Diamond$L*(Q) $\rightarrow$ $\Box^+$L*(Q). By (SN) $\Box^+$L*(Q) $\rightarrow$ L*(Q) holds at the actual world. And so: $\Diamond$L*(Q) $\rightarrow$ L*(Q) holds. Since L*(Q) is an arbitrary possible law we can conclude that all possible laws hold in all possible worlds including the actual one. (The assumption of S5 is tantamount to (a) assuming that when I say that if the law L(P) holds in the actual world then it holds in all possible worlds I mean *all* possible worlds, not just some proper subset of the possible worlds that are accessible from the actual world (i.e. the relevant accessibility relation is universal from the actual world) and (b) assuming that the actual world is not privileged as regards the accessibility relation (i.e. the relation is universal from all possible worlds).) According to strong necessitarianism there is no difference between possible worlds as regards their laws; nomologically, they are identical.

3.2 Strong necessitarianism

Dispositional essentialism cannot itself decide between the weak (conservative) and the strong (radical) version of necessitarianism. While dispositional essentialism entails the weak view it is also consistent with the strong view. I shall in this section explore the strong necessitarian account in more detail in order to show that it is indeed consistent.[49]

[47] Given the distinction between a proposition's being true of a world and its being true at a world, it is less plausible that a proposition can be true at a world where the corresponding fact does not exist. We would thus describe the Kaplan view mentioned in footnote 46 as saying that 'Blair is Orwell' is true of all possible worlds, but only true at some of them.

[48] Armstrong (1983: 163, 166) makes a distinction between strong and weak necessity along these lines. He takes ordinary necessity as applied to laws to be equivalent to my strong necessitarian view, i.e. $\Box^+$L(P), so weak necessitarianism is expressed thus: $\Box^+$(the universal P exists $\rightarrow$ L(P)).

[49] Simon Bostock (2003) argues for strong necessitarianism.

3.2.1 *Strong necessitarianism and properties*

A world in which L(P) is true and P does not exist is a refutation of strong necessitarianism. Since necessitarianism in general takes L(P) to be necessarily true if true in any world, it follows that strong necessitarianism must take P to exist at all possible worlds if L(P) is a law at any world. Let Q be a property that exists at some possible world w. Since Q has a dispositional essence there will be a law L*(Q) in which Q participates. Since all possible laws are actual and all actual laws are necessary, it follows that Q exists in the actual and in all other possible worlds. So any possible property is actual. The view that all laws hold in all worlds (understood non-trivially) entails the view that all (nomic) properties exist in all worlds.

If, as I have argued (Section 2.1.2), properties are universals, strong necessitarianism is committed to the claim that all possible universals exist in all possible worlds. David Armstrong holds that it is a necessary condition on the existence of a universal at a world that it should be instantiated at that world (Armstrong 1997: 38-53). These two together yield the conclusion that every possible universal is instantiated in the actual world. This may seem an implausibly strong conclusion. In the next section I shall examine Armstrong's grounds for the instantiation condition. In the section following that I shall ask whether the view that every possible universal is instantiated is really so implausible.

3.2.2 *The instantiation condition*

Armstrong's instantiation condition on universals is the modern equivalent of Aristotle's *in re* conception of substantial forms: the forms exist through substances.[50] Aristotle's view conflicts with the Platonic *ante rem* conception of forms as existing independently of any object having them. Unlike the *in re* conception, the *ante rem* conception of universals would permit all properties to be actual without them all being instantiated.

Aristotle's objection (*Metaphysics* 13.1079b11-13.1080a10) to Plato's conception was principally that the envisaged instantiation relation between some physical object in space and time to an entity (the form, or *ante rem* universal) outside of space and time is too obscure to explain anything. Aristotle's contrasting view appears to be, then, that the form wholly exists in (where 'in' designates genuine spatial location) each of its instances. But how one entity can be wholly located in several distinct physical locations simultaneously seems equally obscure. The defender of Aristotle might respond that that is just the nature of a universal and what distinguishes it from a particular. Yet that is no more satisfactory an answer than the Platonic claim that the nature of a universal is that it stands outside space and time and relates equally to all its instances. Indeed, the latter can be glossed this way. *Facts* exist outside space and time. That is clear for the facts that salt dissolves in water or that the universe is infinite or that Charles is the son of Elizabeth. And facts explain things.[51] So, contrary to Aristotle, entities outside space and time can explain. Furthermore, since univer-

[50] Another contemporary proponent of the Aristotelian view is E. J. Lowe (2006: 99).

[51] Cf. Mellor's (1995) view, for example, that facts are causes and effects.

sals are components of facts, we can see how universals, though also outside space and time, can contribute to explanations. The Aristotelian might argue for a derived notion of location for facts: the fact that Charles is bald is located where Charles is, or at least where his head is. But in that case the Platonist can use the same derived notion to say that the forms are located in space and time wherever they are instantiated. For the Aristotelian *in re* view to be genuinely distinct from the Platonist view then the location of a universal, call it U_1, in its object, call it **a**, must be a genuine spatial fact rather than a mere *façon de parler*. In which case there must be some spatial universal U_2 instantiated by U_1 (perhaps a relation between U_1 and **a**'s location). But since U_2 is also a universal that is instantiated in entities (such as U_1) that have a spatial location, U_2 must have a spatial location also, and by the same reasoning as before, that fact must involve some third universal U_3. Thus we have a regress of ever high-order universals of spatial location—or a circularity of self-instantiation if we allow that U_2=U_1.[52] While I do not regard such a regress or circularity as damning, I note that the issue simply does not arise if one adopts the view that there are no genuine facts about the spatial location of universals, i.e. the Platonist *ante rem* view. I note also that Armstrong's view is asymmetrical with regard to space and time. Let the world *w* have a single blue object at location *l* that remains blue until time *t* after which it is red. The blueness universal is located at *l* until *t*, but not thereafter; and at no time does the blueness universal exist anywhere other than at *l*. Does it exist after *t*? Armstrong's answer is that it does: instantiated at one time suffices for a universal to exist at all times. But note the asymmetry with space, since instantiation at one place does not suffice for existence elsewhere. Put another way, the Aristotelian wants to tie existence and instantiation. But Armstrong seems willing to break the tie at least as regards the temporal dimension. But that now gives us an example of uninstantiated universals—uninstantiated at particular times (after *t* for blueness in *w*) not at all times, admittedly. Nonetheless, we need to have some explanation as to why the past or even future instantiation of a universal suffices to make it exist now; and we need to know why cases of universals that exist uninstantiated at *t* do not fall foul of the Eleatic Principle (see below) which Armstrong wields against Platonic universals that may exist uninstantiated at all times.

Thus there is an alternative view that makes a stricter tie between existence and instantiation—universals exist only where *and when* they are instantiated. But this makes serious trouble for Armstrong's account of laws (which is presumably why he does not adopt the view). For laws, on his view, are relations among universals, but no such relation can hold without the existence of its relata. Thus if a universal were to cease to exist, then the law would cease to hold. But it would be most odd if a particular, merely by changing its properties, could cause a law to go out of existence.[53] This problem is avoided by relaxing the link between instantiation and existence as

[52] I think that Evan Fales (1990: 172) is making this point, albeit in a slightly different context.

[53] Fales (1990: 216) thinks that the consequence that the change of properties can cause the *universal* to go out of existence is itself a reason to take universals to be transcendent rather than immanent. That may be, but causing a law to go out of existence is even worse. See Fales (1990: 215-19) for further arguments in favour of transcendent, Platonic universals, in the same tenor as those presented here. I note also that

regards time. But that is not sufficient to avoid all problems of this form, as we may see by considering trans-world rather than trans-temporal differences. The instantiation condition still makes the existence of laws and properties implausibly sensitive to contingent differences (and nomically contingent differences at that) in the existence or even location of rare particulars. If, as Armstrong does, one admits that particulars exist contingently, it seems plausible that one ought to be able to have two worlds that are alike in respect of their laws but differ in that one has a particular that the other lacks. But Armstrong's position is incompatible with this. For one may imagine a law L involving a universal U where the only particular in world w_1 that is affected by this law and instantiates U is the particular **a**. Now consider w_2 which is as similar to w_1 as can be except that **a** does not exist in w_2. On Armstrong's view U cannot exist in w_2 and so neither can L. There seems no reasonable explanation as to why the removal of a contingently existing entity should also remove a law. The problem is made more intense when we consider that the difference between w_1 and w_2 need not be a difference in **a**'s existence but in **a**'s location. Let **a** and **b** be entities (and the only entities) of kind K. In w_1 **a** is 0.9m from **b**; and in w_1 there is a law L that states that entities of kind K that are less than 1m apart interact in manner M, where M is a universal exclusive to this law (i.e. nothing else other than **a** and **b** are M in w_1). In w_2 **a** and **b** also exist and are the only K-entities. But in w_2 they are 1.1m apart and so L does not apply to **a** and **b**, and so nothing in w_2 is M. But if nothing is M, then according to Armstrong M does not exist and so neither does L. While we can understand that the 20cm difference in location of **a** between w_1 and w_2 may make a difference to what happens to **a** it is implausible that it makes a difference to which laws there are. Consideration of such a case lends support to Shoemaker's contention that universals concern ways things could be, not merely the way any things actually are.

The spatial version of this argument is to all intents and purposes the same as Charlie Martin's example of the non-interacting particles (Armstrong *et al.* 1996: 74) and a similar case discussed by Michael Tooley (1977: 669). Armstrong's reply to Martin and Tooley, adapted to this case, states that there need not be any counterfactual fact of the matter, regarding w_2, as to what would have happened had **a** and **b** been 20cm closer together. Armstrong does not explain why we should believe this, except to argue that the view is not absurd, by analogy with a case of an irreducibly probabilistic event, such as a nuclear decay. In the latter case we cannot say that either had the particle been excited, it would have decayed nor can we say had the particle been excited, it would not have decayed. Even if we allow Armstrong's position to be coherent, it gives us no reason for saying that as regards w_2 it must be false that had **a** been 20cm closer to **b**, **a** and **b** would have been M, which is what Armstrong's instantiation condition requires us to say.

Armstrong thinks of universals as ways in which things stand towards one another. He says it is implausible that there should be such ways without there be-

Max Kistler (2002) permits uninstantiated universals in the context of his Causal Criterion of Reality, which functions similalrly to the Eleatic Principle.

ing things standing in such ways. To this Sydney Shoemaker replies that one could equally characterize universals as ways things can stand towards one another. And things could be thus and so without their actually being thus and so. Armstrong rejects this objection on the grounds that it makes universals necessary beings (Armstrong 1997: 38). This of course is no cause for concern to the strong necessitarian who happily accepts this proposition. This consequence of uninstantiated universals is a problem only for someone adopting Armstrong's contingentist views about laws and properties. (It might be added that one could interpret Shoemaker's *can* as a matter of nomic rather than metaphysical possibility—a way things could be in this world with its laws. So for someone like Armstrong who thinks laws are contingent, universals would still be contingent entities.)

Armstrong does marshal another argument against uninstantiated universals, viz. that they contradict the Eleatic Principle (Armstrong 1997: 41):

> Everything that exists makes a difference to the causal powers of something.

While the Eleatic Principle is contentious and its correct formulation even more so, the dispositional essentialist is certainly in sympathy with its motivation. According to (DM) properties have their powers essentially; indeed their powers may even serve to individuate properties, as we shall discuss in Chapter 4. In this sense, the dispositional essentialist necessitarian can claim to adhere to the Eleatic Principle more closely than an Armstrongian or Humean contingentist, since the latter hold that the difference a property makes to the causal powers of things is only a contingent difference, whereas according to the necessitarian, properties make their differences necessarily.[54] Furthermore, there is no reason inherent in Armstrong's categoricalist metaphysics that rules out the possibility of a universal that fails to be involved in some law and so which even when instantiated makes no causal difference to anything. So the main component of Armstrong's metaphysics is consistent with the denial of the Eleatic Principle. The essentialist view of properties, by contrast, explains why the Eleatic Principle is true of properties, because it requires all properties to have causal (or nomic) powers.

Armstrong's concern is that an uninstantiated property makes no difference to the causal powers of anything and so should not be admitted, thanks to the Eleatic Principle. But, first, the principle cannot be applied to necessary existents. And secondly, even if it is applied, uninstantiated universals need not fall foul of it.

The principle seems plausible as a claim about contingent entities, especially particulars. One might well be disinclined to think that if two worlds allegedly differ with respect only to the existence in one but not in the other of some entity, which itself is causally impotent, then there really is no difference between the worlds. But this sort of argument will not work for necessary entities, since worlds cannot differ with respect to them. Armstrong's 'makes a difference' clause suggests a comparison between having the entity and not having the entity, and that comparison makes

[54] This point is implicit in Kistler (2002).

no sense with respect to necessary beings. But the universals we are considering are intended to be precisely that.

Nor is it so clear that uninstantiated potencies really do violate the Eleatic Principle, properly understood. Armstrong's use of the principle seems to suggest that the the 'something' must be a particular and gives the impression that the something must be something *else*. First, if one is a genuine, full-blooded realist about universals, one should be happy to allow the 'something' to quantify over universals as well. Secondly, the something should not *have* to be a something else, unless it is the world as a whole. Two worlds might differ with respect to some causally isolated particular—it itself is replete with powers but they don't affect the powers of anything else because of its isolation. Presumably the principle is not intended to exclude such a difference. In which case we should understand the introduction of this particular as making a difference to the causal powers of either itself or of the world as a whole. If we are permitted to say that, then we can also say that the existence of an uninstantiated potency makes a difference to the causal powers of either itself (because it is itself identical with certain powers) or to those of the world as a whole (for the same reason).

Armstrong officially regards universals as part of the furniture of the universe. He rejects nominalist views that take only particulars to exist. But the instantiation condition seems to be a failure of nerve as regards realism about universals. If universals really are entities in their own right, why should their existence depend upon a relationship with existing particulars? A tentative diagnosis of the failure of nerve is this. Armstrong's metaphysics takes universals to be *categorical* properties. That is, he denies dispositional essentialism. Universals do not have their powers essentially, but instead they have them contingently. All that can be said about the essence of a categorical property is that it is identical with itself and distinct from other things.[55] It may be that Armstrong fears that such an entity is too spectre-thin to really exist without the backing of something else more substantial.[56] (Recall that Armstrong's reading of the Eleatic Principle took the quantifier 'something' to range over particulars but not universals.) So for Armstrong, it is the instantiation of the property in a particular that gives it the required backbone. This is a speculative diagnosis. It is perfectly coherent to take an Aristotelian view of potencies, and in the next section I show that such a view is possible. Nothing in the other parts of this books depends on a Platonic rather than an Aristotelian view. Nonetheless, if one does feel that instantiation gives categorical properties a robustness they would otherwise lack, then that is of course a motivation that cannot apply to the dispositional essentialist view of universals. According to that view universals do have a contentful essence, instantiated or not—their dispositional powers.

[55] I shall discuss categorical properties and the alternative to dispositional essentialism in greater detail in the next chapter.

[56] Jon Jacobs has suggested to me an alternative diagnosis. On the basis of some general objection to abstracta, one might adopt the Aristotelian *in rem* conception of universals as part of (and located at) their instantiations. Then an uninstantiated universal faces the problem that it has no instantiation to be part of. In which case, where is it?

3.2.3 *Strong necessitarianism with instantiated properties*

In this section I wish to explore the combination of strong necessitarianism with Armstrong's instantiation condition. One reason for looking at this view is that it is the *prima facie* least plausible version of the strong necessitarian view. Indeed to many it may look to be in danger of being inconsistent. The combination requires that every possible property is not only actual but is also instantiated. The following (toy) example might suggest this.[57] Let us assume for convenience that all laws are generalizations. One possible law says 'all grass is green' and another says 'all grass is red'. Since these are both possible they are both laws. The two generalizations can both be true without generating any contradiction but only so long as there is no grass. But if every property is instantiated there will be some grass, and that grass will be both green and red. So it looks as if the instantiation condition leads to a contradiction in a way that strong necessitarianism without that condition does not.

The necessitarian answer is simple. In such a case at most only one of 'all grass is green' and 'all grass is red' is a law. The ambitious dispositional essentialist holds that all laws are consequences of the essences of properties. Let us say then that it is a law that all grass is green. This will be because the essence of the property, being grass, involves the disposition to be green in normal conditions.[58] In which case that essence will not involve a disposition to be red. Since laws follow from the essences of properties, and since the property of being grass does not involve the disposition to be red, there will be no law that all grass is red. If we regard the dispositional essences as determining the identities of properties, then if X and Y have distinct essences, X≠Y. So if the essence of grass involves the disposition to be green, then any property that involves the disposition to be red cannot be the property of being grass. The thought that both generalizations could be laws arises only for those still in the grip of the contingentist view of laws and the categoricalist view of properties that goes with it. On those views any property might be involved in a law with any other property. Clearly then the instantiation of all possible laws is impossible, for just the reason considered, that grass would be both green and red. But the dispositional essentialist denies that a property can be involved in just any law with any other property.

This response shows how to block a parallel but slightly more subtle objection to strong necessitarianism in general (even without the instantiation condition). With instantiation 'all grass is green' and 'all grass is red' lead to a contradiction. Without instantiation these generalizations are consistent (they are both vacuously true). But the laws that grass is green and that grass is red are not consistent. This is because laws entail counterfactuals. In this case we would have the inconsistent counterfac-

[57] The illustrative example is a toy example because it is unclear that the relevant properties (being grass, being green, etc.) are genuinely sparse. And they certainly are not fundamental. So 'grass', 'green', etc. are standing in for genuinely sparse and fundamental properties.

[58] We presume that the stimulus is a standing condition, and that this standing stimulus condition is the same stimulus for all the dispositions discussed in this example. What is being said is that this dispositional essence of P cannot involve both $D_{(S,M)}$ and $D_{(S,\neg M)}$. However, if complex essences are permitted, then P might well have an essence involving both $D_{(S,M)}$ and $D_{(S^*,\neg M)}$, so long as S and S* are incompatible stimuli. Such essences will not lead to inconsistent laws.

tuals, 'if there were grass, it would be green' and 'if there were grass, it would be red' (which are inconsistent if the existence of grass is possible). The answer is just the same. It is not the case on the necessitarian view that both grass is green and grass is red are both (possible) laws.

A different objection to strong necessitarianism when combined with instantiation goes as follows. 'One might imagine that the actual world contains more laws than we think, perhaps even all possible laws, so long as they are uninstantiated. Being uninstantiated they would be inert and would have no impact upon us. But if they were instantiated then they would impact upon us. If all the possible laws were actual and instantiated, they would be doing things to existing entities and we would expect to be able to detect them. But we do not detect them. The laws we do know about (even if only partly, at the most fundamental level) seem to be only a subset of all the possible laws. And so strong necessitarianism with instantiation looks to be in conflict with the empirical evidence.'

The key move in this argument is the sentence, 'But if they were instantiated they would impact upon us', amplified in the one following it, 'If all the possible laws were actual and instantiated, they would be doing things to existing entities and we would expect to be able to detect them'. There is no reason to suppose that these claims are true. Laws form integrated, systematic sets or networks. This much is widely acknowledged and even forms part of the analysis of law on the Ramsey–Lewis view. In the dispositionalist picture, integration in a network occurs because the manifestation property of one disposition may be the stimulus property of another, and so on. This may go round in a full circle.[59] A simple case will be when we have two properties. For example, gravitational mass may be regarded as the disposition to transform spacetime while spacetime is the disposition to affect the motion of gravitational masses (although in this case it is probable that these dispositions reflect a deeper system of integrated fundamental dispositions upon which other dispositions supervene). So all the possible laws will divide up into discrete sets (possibly singleton sets) such that each member of the set integrates with other members of the set but not with any laws outside the set. Take any entity. The existence and nature of that entity are determined by the laws that govern it. For example a water molecule exists and is what it is thanks to the laws of quantum mechanics. Those laws not only determine the existence and nature of the molecule's atomic and subatomic parts but also explain the existence of the molecule itself, by explaining the ability of oxygen and hydrogen to bond together; and in turn thanks to the details of that bond, the laws of quantum mechanics also explain water's properties (such as its ability to dissolve salt). So our entity, whatever it is, will have its existence and nature associated with some set of systematically integrated laws but, because they are discrete, not with any other. So entities associated with distinct sets of laws will not interact; they will be causally isolated from one another. Now consider that we as observers are just a certain kind of complex entity governed by one of the sets of laws.

[59] This forms the basis of the regress objection to dispositional monism. I shall examine this objection and the nature of law networks in Chapter 6.

From what has just been argued, we could not interact with and so could not detect any entity governed by a different set of laws. So it is not true that should laws from a distinct set be instantiated, we might expect to detect such laws and the entities instantiating them. Indeed we know we could not detect them.[60]

3.2.4 *Evaluating strong necessitarianism*

I have sought primarily to show that strong necessitarianism is a consistent position. Are there however reasons to think that strong necessitarianism is true—or is false? The strongest reason for thinking that the view is false is the force of intuition. We have a strong intuition that the laws of nature are contingent and a strong intuition that the existence of sparse properties is contingent also. In the next section I shall briefly mention why I do not think that the force of intuition provides a strong objection. Note that the intuition that laws are contingent counts just as much against weak necessitarianism as against strong necessitarianism. So only the intuition that the existence of sparse properties is contingent acts against strong necessitarianism specifically. But that intuition does not seem to me to be any stronger or better founded than the former. In which case, if one is willing to swallow one's intuitions to the degree of going along with necessitarianism at all, intuition should not itself be allowed to incline one towards the weaker version rather than the stronger.

What reasons might incline one towards the stronger view? Above we came across Shoemaker's view that properties could be regarded as ways things *can* be. If we regard this 'can' as metaphysical rather than nomic, then the way a thing can be is something that will be shared by all possible worlds, assuming S5. (The conception of properties as ways things can be is consistent with dispositional essentialism. The latter adds that for a thing to be a particular way is for it to be disposed to behave in a certain way.)

The strong necessitarian view has an advantage over its competitors in the realm of explanation. Laws and causal powers are essential components of explanations. Sometimes we are able to explain a law or power by showing it to be a consequence of some set of deeper laws or powers. That invites an explanation of those deeper laws and powers. A regress threatens that leads either to an infinite chain of laws or powers or, more likely, to a fundamental set of laws or powers that cannot themselves be explained. Some have regarded this as a reason to think that the very idea

[60] For this reason Bostock (2003: 526-7) calls the laws in law networks that do not govern us and our stuff 'spooky' laws. These are laws containing Lewis's *alien* universals. Bostock thinks that the isolation of spooky laws and alien universals is a reason to deny their existence. From which he concludes that each world has only one network—although he does recognize that is contentious. And indeed, I do not see the reason to reject spooky laws. Kistler (2002: 75) seems to allow for worlds with both actual and alien universals.

However, if Bostock were right that only one network is possible, then the conclusion that all worlds have the same laws would follow quickly, as he intends. In Chapter 6 I discuss the constraints on networks of laws and these give no reason to suppose that only one network is possible. Bostock asks why, if there is more than one possible network, all possible worlds should have all the possible networks. I do not think that there is a compelling argument, and so I present strong necessitarianism only as a consistent alternative to weak necessitarianism rather than as positively required. However, a platonic conception of properties (universals) as necessary beings would provide an argument of the kind required.

of explanation is an illusion. This is a fallacy; it is not a necessary condition on A's explaining B that we have an explanation for A also. Nonetheless one may be sympathetic with the thought that one's chain of explanations is less satisfactory for lacking an explanation of A, and even more so when told that there can be no explanation of A, since A is fundamental. There is an explanatory lacuna if although the basic set of laws and powers could have been otherwise (as the contingentist holds), there is no explanation of their being as they are; that being fundamental we just have to accept the brute and accidental fact that they are as they are and not otherwise.

If one is sympathetic to that thought, then strong necessitarianism provides a balm. Strong necessitarianism cannot provide an explanation of the same kind for the fundamental laws, since there are no yet deeper or more general laws to explain these. But it can provide an explanation of sorts. Being necessary, the fundamental laws could not have been otherwise. Viewed one way we cannot ask for an explanation of the usual kind at all, for the comparative question, 'why do we have these laws as opposed to some other set?', assumes what is false, that some other set is possible. Viewed another way, the strong necessitarian provides an explanation that is the best possible. A natural way to understand what Hempel (1965) sought in his Deductive-Nomological model of explanation was that he wanted to make precise the thought that a fully satisfactory explanation shows why, given laws and antecedent conditions, the explanandum *had* to be. Where the explanandum is itself a law, antecedent conditions play no role, and so to explain a law is to show how it had to be, given other laws, i.e. to explain L1 one shows that $\Box$(L2→L1) where L2 is another law or set of laws. By this standard, to show that a law had to be, whatever other laws or conditions might be, is an explanation also, indeed as good an explanation as one could hope for. That is, if a demonstration of $\Box$(L2→L1) provides an explanation of L1, then so does a demonstration of $\Box$L1).[61]

3.3 *Ceteris paribus* laws

3.3.1 *Dispositional essentialism and* ceteris paribus *laws*

Above we saw how starting with:

$(CA_{\Box})$ $\quad \Box(D_{(S,M)}x \leftrightarrow Sx \,\Box\!\!\rightarrow Mx)$

and:

(DE_P) $\quad \Box(Px \rightarrow D_{(S,M)}x)$

(where P is some property with a dispositional essence given by $D_{(S,M)}$—such as, according to (DE) a fundamental natural property), we can derive the universal generalization:

(V) $\quad \forall x\,((Px \,\&\, Sx) \rightarrow Mx)$.

[61] Armstrong (1983: 159) records that Martin Tweedale suggests a Rationalist-style argument based on the Principle of Sufficient Reason, in favour of necessitarianism, that is along the same lines as the proposal I put forward here. Armstrong objects that short of adopting a philosophy of the Absolute (the one sole reality from which all the phenomena may be deduced), one will be forced to adopt contingency in our explanations at some point. I am not sure why Armstrong says this. Perhaps the Strong Necessitarian conception of the laws makes them equivalent to the Absolute.

Indeed, instead of ($CA_{\Box}$), i.e. $\Box$(CA), all we strictly need is $\Box$(CA→). However, we have already seen (CA→), and so ($CA_{\Box}$), to be false, thanks to finks and antidotes. If these are the only sources of exception to (CA→), then the following is true:

> (CA→*) if *x* has the disposition $D_{(S,M)}$ then, if *x* were subjected to S and finks and antidotes to $D_{(S,M)}$ are absent, *x* would manifest M.

And if we employ (CA→*) in place of (CA→) our conclusion becomes:

> (V*) $\forall x$ ((D*x* & S*x* & finks and antidotes to D are absent)→M*x*),

or, equivalently,

> (V*) $\forall x$ (finks and antidotes to D are absent → ((D*x* & S*x*)→M*x*)).

We may consider (V*) to be a version of (V) that admits exceptions—in this case the exceptions being instances of finks and antidotes. Laws that admit of exceptions are *ceteris paribus* laws, hence:

> (V**) $\forall x$ (*ceteris paribus* ((D*x* & S*x*)→M*x*)).

So (DE) explains not only strict laws—(V)—but also *ceteris paribus* laws—(V**).[62]

This relationship between finks, antidotes, and *ceteris paribus* laws allows us to address the question, are *ceteris paribus* laws a macro-only phenomenon? Or might even the fundamental laws be *ceteris paribus* laws, as Nancy Cartwright (1995) thinks? Since *ceteris paribus* laws arise when the dispositions that generate the laws suffer from finks and antidotes, these questions may be answered by considering whether fundamental dispositions also suffer from finks and antidotes, which I do in the following two subsections.

3.3.2 *Finks at the fundamental level?*

We have seen finkishness at work at the macro-physical level. Is it possible that finks operate at the most fundamental level of disposition, that is to say of fundamental potencies? In this section I ask whether fundamental dispositions can be finkish. In the next section I ask whether they can suffer from antidotes.

The standard cases of finkish dispositions are those where the causal basis for a disposition is removed before it can complete its causal work that would otherwise lead to the manifestation of the disposition. In the case of a fundamental disposition there is no distinct basis. Hence there can be no cases of finks of this sort.

However, objects can be made to acquire or lose dispositions not only by causing them to gain or lose their distinct causal bases. It must be possible for an entity to gain a fundamental potency directly. For example, electrons can be spin-up or spin-down and they can be caused to change from one to the other. If these are fundamental properties then the interactions that result in a change of spin direction will act by bringing about this change directly, rather than indirectly by causing a change at some even deeper level of property.

Thus it does look as if there might be room for finkishness of fundamental properties. Let D, S, and M be instances of a potency and its characteristic stimulus and manifestation in some object *x*. A case of finkishness would have to operate like this.

[62] Strictly these *ceteris paribus* laws are those, in Joseph's (1980) terminology, that are *ceteris absentibus*.

The object x with D receives stimulus S. However, before manifestation M can occur, x is caused by a finkish intervention to lose D and so fails to manifest M. Now for this circumstance to arise, the following must be true:

> (i) The manifestation of a fundamental disposition must not be instantaneous. If it were, then there would be no time for the finkish intervention to work before M occurs. The intervention must occur before M would have occurred, which requires M to happen after S, not simultaneously with S.
> (ii) Furthermore, the manifestation of a fundamental disposition will also require the continued possession of D for some period of time. The time gap referred to in (i) is not enough to permit finks. One could imagine a disposition operating thus. The occurrence of S at time t when x has D, is sufficient to produce M at a later time t'. It is not required that x continue to possess D. In which case the fact that an intervention after the occurrence of S removes D is irrelevant to the occurrence of M. That occurrence is already guaranteed. So for an intervention to be finkish and prevent M by removing D, it must be that D is required to persist for M to occur.

The existence of a fundamental disposition with these characteristics raises interesting questions, primary among which is, are such properties really possible? It is easy to see how a non-fundamental property might have such characteristics. For in such cases the manifestation of the disposition will be the result of a process involving its more-or-less complex causal basis—when for example the breaking of the vase is the outcome of forces, stresses, and cracks spreading throughout the vase. But in the case of a fundamental property which by definition has no causal basis, it becomes mysterious why there should be a time gap between stimulus and manifestation and why the persistence of the disposition itself should be necessary. Let us consider a set of states of affairs starting with the stimulation of D by S at time t. Let it be that D must remain until $t+\delta t$ in order for M to be manifested. Let it be that D does indeed remain until $t+\delta t$. Further assume for simplicity that M is manifested at $t+\delta t$. There is no difference between any of the states of affairs between t and $t+\delta t$. There is nothing intrinsic to any of these states that distinguishes it from any other. Consequently there is nothing that acts as a clock (such as an unfolding process in the causal basis of an object with a non-fundamental property). So what is the difference between the state at $t+\delta t$ and the state at $t+0.5\delta t$ which accounts for the fact that the occurrence of the former permits M to occur, but the occurrence of the latter does not?

The conclusion I draw is that because there is no intrinsic difference between the states of affairs, one cannot have a consequence that the other does not have, and so the assumption that the occurrence of M depends on the occurrence of one of these states in a way that it does not depend on the other is erroneous. This leads to the following. Either the manifestation of a fundamental disposition is instantaneous. Or the supposed intermediate states, such as the state at $t+0.5\delta t$ do not exist. That is, the first state of affairs to occur after that occurring at t is in fact that occurring at

$t+\delta t$. This exclusion of temporally intermediate states of affairs would be the case, for example, if time is quantized.

If so, then finkishness is not after all possible for fundamental dispositions. For if the manifestation is instantaneous, then, as we have already seen, there is no opportunity for the finkish intervention to occur. If, on the other hand, time is quantized, and the manifestation occurs at the next possible moment, there is no intervening possible moment at which the finkish intervention can occur.

In this example I assumed that M is manifested as soon as the minimum time, δt, for D's retention has elapsed. The requirements (i) and (ii) also allow for cases where there is a further time lapse before M is manifested. Clearly such cases are not materially different, as far as my argument is concerned, from the simple case where there is no additional time lapse. Indeed they just add an additional mystery of the same sort as far as the states during the second time lapse are concerned.

The conclusion of this section is that finkishness cannot occur at the fundamental level—there are no finkish fundamental potencies. The next section considers whether there can be antidotes to fundamental properties. This is a more important question, since antidotes are more common than finks, and, as we shall see, a more difficult question also.

3.3.3 *Antidotes at the fundamental level?*

Antidotes present a kind of case that is in principle rather different from finks. For here the failure of a disposition to manifest itself is due to interference not with the disposition itself but rather with the additional conditions that are required. In which case there is no requirement, as there is with finks, that the antidote act after the occurrence of the stimulus but before the manifestation would have occurred. The antidote might have been in play long before the stimulus. One can take an antidote for a poison before ingesting it. Hence the considerations that allowed us to exclude finks at the fundamental level are not relevant to antidotes.

A superficially plausible route to eliminating antidotes at any level is to recast the disposition under consideration. If A is an antidote to the disposition D to yield M in response to S, then we could replace D by the disposition D* to yield M in response to (S in the absence of $A_1, A_2, A_3, \ldots$), where $\{A_1, A_2, A_3, \ldots\}$ is the set that includes every possible antidote to the original D. We considered this kind of move in Section 2.2.9, for the case of D being a covert disposition. But the problems raised were general, and suggested that we may not in general substitute an antidote-free disposition for an antidote-sensitive one without loss.

On the face of it, that consideration makes it more plausible that we should expect to find antidotes at the fundamental level. If we were able to replace every antidote-sensitive disposition by an antidote-free disposition, then we could do this with fundamental properties also. And so we could in effect do science with just the latter, ignoring or eliminating antidote-sensitive dispositions. The arguments of Section 2.2.9 suggest that in general we may not make such replacements.

Nonetheless, I believe that the grounds against elimination in the general case have rather less purchase at the fundamental level. We saw first that the possibil-

ity of multiple realizability meant that the replacing antidote-free disposition had less explanatory power than the antidote-sensitive disposition it was replacing. However, when it comes to fundamental dispositions these have no realizers distinct from themselves. So the multiple realizability problem cannot arise.

Consequently the obstacle to regarding fundamental properties as replaceable by antidote-free dispositions comes from the possible complexity of the manner of their manifestation. The most obvious source of complexity came, in the general case, we saw, from the fact that there a higher-level disposition manifests itself by relying on a mechanism that operates at a lower level. Even though the effect of a quick-acting poison may look straightforward at the macro-level, the process by which it kills its victim might well depend upon a complex lower-level biochemical process. Again this does not apply to the case of fundamental properties. They cannot bring about their manifestations through a mechanism operating at a lower level, since they are at the lowest level themselves.

This does still leave open two remaining possibilities.

> (a) That there is a mechanism involving just properties at the fundamental level;
> (b) That there is no mechanism bringing about the manifestation M—it is brought about by D and S together directly. However, the further possible condition A is such that D and S will not bring about M.

Regarding (a), one might suppose that the mechanism might break down into intermediate steps. Consider a row of one hundred dominos standing next to one another. It may be true to say that the first domino is disposed, given the stimulus of being knocked over, to bring about the fall of the 100*th* domino. We can describe and understand this mechanism without descending to a lower level (unlike the poisoning case). But for that very reason it seems natural to break down this process into one involving ninety-nine dispositions all operating at the same level. Thus while the original disposition has an antidote at the same level (for example, removing the 29*th* domino) the constituent single-step dispositions do not have such an antidote. If so, then at the fundamental level one might expect antidote-sensitive dispositions to be regarded as made up on a sequence of antidote-free dispositions.

Regarding (b) it is less clear that the antidote-sensitive disposition can be replaced by an antidote-free one. However, one might be less sceptical about the eliminativist route considered above. Since we are dealing with the fundamental level, and have already removed the problem of multiple realizability, it might be reasonable to expect that any dispositions of this sort will suffer from relatively few antidotes. In which case their incorporation into an antidote-free disposition will not look so gerrymandered. Thus in this case it will be up to our fundamental science to decide whether there are antidote-sensitive dispositions and *ceteris paribus* laws. But the direction of the development of physics with ever fewer fundamental properties and corresponding forces indicates that the prospects for antidote-free fundamental properties and thus strict laws only at the fundamental level are promising.

3.4 Conclusion

If we accept dispositional essentialism—the claim that potencies, properties which have dispositional essences, exist—then we automatically have an account of the laws of nature. Laws may be considered as natural regularities; in which case laws can be understood as the regular relationship between a dispositional property and a stimulus on the one hand and the manifestation on the other. This regularity is underwritten by the subjunctive character of the disposition. Alternatively, laws may be conceived of as a relation between properties, in which case the very nature of a potency provides what we want for a law, since its essence is a dispositional relation between a stimulus property and a manifestation property. The modal character of essence means that we have an account of the necessity that is naturally thought to characterize laws of nature; necessarily if the potency is instantiated and receives its stimulus, then the manifestation will occur.

What makes this differ from the necessity that Armstrong sees in laws is the fact that, since it derives from the essence of potencies, it is *metaphysical* necessity. Armstrong's necessitation relation is a weaker *sui generis* and contingent kind of necessity—in the next chapter I demonstrate the instability of Armstrong's position. A consequence is that the dispositional essentialist is committed to the metaphysical necessity of laws. Given the prejudice in favour of the contingency of laws this might be thought to be a disadvantage. But this prejudice is misplaced (as I will argue in Chapter 8). In the light of this, the metaphysical necessity of laws should be seen as an advantage since it explains what the necessity we attach to laws is.

One may perfectly naturally take the necessity of laws to be a necessity that is slightly restricted in the way that the necessity of identity is. The latter does not require that every individual exist at every possible world. Likewise a world could lack a law that another world possesses. It would achieve this by lacking the potency that underwrites that law.[63] This requires an Aristotelian *in re* conception of universals according to which there are some worlds where the universals do not exist (namely those where they are not instantiated). That is a perfectly acceptable position as far as the dispositional essentialist is concerned. Nonetheless, it is worth exploring what the consequences would be of taking the alternative Platonic *ante rem* conception according to which universals exist outside space and time and exist at all possible worlds. That view of universals has more going for it than is often supposed. And if it is true it generates a stronger kind of necessity for the dispositional essentialist. All possible laws hold in all possible worlds; all worlds are nomically identical. I stress, however, that this stronger necessitarianism is not obligatory for the dispositional essentialist, who is entitled to rest content with the weaker version.

The straightforward dispositional essentialist account of laws equates dispositional character and subjunctive conditionals, as is found in the conditional analysis of dispositions. But we know that the latter is false because dispositions typically suffer from finks and antidotes. However, far from being an objection to this account

[63] Bostock (2003) regards this as the explanation of the alleged contingency of laws. But I do not agree, since it fails to explain why we think that there are worlds with counterexamples to our laws. In Chapter 8 I develop a different explanation of the illusion of contingency.

of laws, that fact is an advantage since it permits us to add necessary detail to the account. For the simple account of laws generates strict laws. But many laws are not strict but are *ceteris paribus* laws. The latter may be accounted for by noting that finks and antidotes are precisely conditions that need to be excluded by the *ceteris paribus* clauses in *ceteris paribus* laws.

Consequently, if we want to know whether there are *ceteris paribus* laws at the most fundamental level, we need to ask whether the most fundamental properties are antidote-sensitive dispositions or antidote-free dispositions. One route to an answer to this question is something of a blunt instrument. It argues that all antidote-sensitive dispositions should be replaced by antidote-free ones. However, the basis for this reductionist or eliminativist programme is weak for several related reasons. In summary those reasons show that the proposed replacements are explanatorily weaker and less natural than the dispositions they replace.

Nonetheless, we also find that the reasons for resisting reductionism and eliminativism have rather less purchase when it comes to fundamental properties, since they arise primarily in those cases where the disposition supervenes on a deeper-level structure and mechanism. While I do not regard my arguments as conclusive, it has been shown that it is at least plausible to suppose that antidotes may be a purely macro-level phenomenon and so are not to be found at the fundamental level. If so the same may be said for *ceteris paribus* laws also.

4

CATEGORICALISM

Dispositional essentialism contrasts with a number of traditional and more modern views about the natures of properties and laws, and their roles in explaining the truth of conditionals. The contrasting view of properties I have called *categorical monism* or following David Armstrong, *categoricalism*, for short. With categoricalism are associated two view of what laws are, the regularity view and the nomic necessitation view. These views have until recently been regarded as the main rivals in the metaphysics of laws. However, from the point of view of dispositional essentialism, the main error in both of these views lies in their shared commitment to categoricalism. The purpose of this chapter is to explicate categoricalism about properties and the two corresponding categoricalist views of laws and then to expose the faults in each.

4.1 Categoricalism about properties and laws

Categorical monism (categoricalism) I defined as the view:

> (CM) All sparse, fundamental properties (and so all sparse properties) are categorical.

The term 'categorical' can be subject to misleading connotations. One such invites the following thought. An essentially dispositional property is only sometimes there, viz. only when it is being manifested in response to the appropriate stimulus; that is, the property's *instantiation* is conditional on that stimulus. By contrast, a categorical property is always there; it is not there conditionally on anything. This thought is a mistake. Dispositions exist and are really there whether or not they are manifesting—the fragile vase is fragile even when not being struck and being broken. The fact that the manifestation is conditional on the stimulus does not make the disposition itself conditional on the stimulus. Nor should we see categorical properties as permanently manifesting properties—manifesting their own existence. First, a genuine disposition might permanently manifest itself, perhaps even necessarily so, without that making it categorical. Secondly, a manifestation is distinct from the property itself. To say that a property manifests itself in its own existence is to state a truism that holds of every property, dispositional or categorical.

What we mean by 'categorical' must be understood in negative terms. That is, a categorical property does not confer of necessity any power or disposition. Its existence does not, essentially, require it to manifest itself in any distinctive fashion in response to an appropriate stimulus (Armstrong 1997: 80-3). The categorical versus essentially dispositional distinction is a modal one. To say that a property is cate-

gorical is to deny that it is necessarily dispositional (Armstrong *et al.* 1996: 16-17).[64] More generally fundamental categorical properties have no necessary connections with other entities.[65] Categorical monism is the claim that all sparse properties are like this. Thus categorical monism, dispositional monism, and the mixed view, according to which some properties are categorical while others are essentially dispositional, are three mutually exclusive positions.

According to (CM) the nomic (and causal, etc.) features of a sparse property are contingent. In other possible worlds they might be connected in other laws with universals with which they have no connection in this world. Hence the dispositional character, the causal powers and other such features of properties are not essential to them. Using the terminology of 'universals', David Lewis (1986*b*: 205) says, 'there isn't much to the intrinsic nature of a universal' and as Robert Black (2000) describes Lewis's view of properties, 'Lewis follows Hume in denying that fundamental properties have, let alone consist of, essential causal powers . . . Just about all there is to a Humean fundamental quality is its identity with itself and its distinctness from other qualities. A Humean fundamental quality is intrinsically inert and self-contained.'

The modal character of properties, according to both Armstrong and Lewis, and to the categoricalist more generally, may be summed up thus:

> PROPERTIES Properties are categorical in the following sense: they have no essential or other non-trivial modal character. For example, and in particular, properties do not, essentially or necessarily, have or confer any dispositional character or power. Being made of rubber confers elasticity on an object, but it does not do so necessarily. Being negatively charged confers on objects the power to repel other negatively charged objects, but not necessarily. In other possible worlds rubber objects are not elastic, negatively charged objects attract rather than repel one another. The essential properties of a natural property are limited to its essentially being itself and not some distinct property.[66]

While according to (CM)/PROPERTIES the dispositional character of a property is in no case essential to that property, it is undeniable that there are properties with a dispositional character. Such a character is not essential or metaphysically necessary—there are other possible worlds where the property lacks that character.

[64] Since there is a distinction between *necessarily* and *essentially*, there could in theory be properties that are necessarily dispositional but not essentially dispositional. In fact I think that *being aqueous* necessarily confers the power to dissolve salt on its instances, but does not have that character essentially. But I doubt whether any fundamental properties are like this.

[65] A non-fundamental property might have necessary connections with its parts. Such necessities will not play a role in what follows. The matter is addressed again in Section 4.4.3.

[66] The essential properties of a property may include the polyadicity it does have. That is, a property that is in fact a monadic universal is necessarily monadic, one that is dyadic is necessarily dyadic, etc. Armstrong (1989*b*) indicates that he holds this to be the case. This calls into question Armstrong's reductive account of modality. MacBride (1999) points out that the account fails also to deal with other modal features that suffuse the very notion of universal—such as its being essential that a universal is a universal and not a particular. While such arguments add to the contentions of this chapter, the details need not concern us further.

Whence, then, does that character arise? The categoricalist regards that character as being imposed upon a property by the laws of nature. Let P be a property that as a matter of fact has the dispositional character given by $D_{(S,M)}$. The categoricalist explanation of this is that there is a law which says that whenever something is P and also S, then it is also M. Since laws support counterfactuals it is true of something that is P, that were it to be S it would be M. For example, the property of being negatively charged has this character: objects that are negatively charged have the disposition to attract positively charged objects. On the categoricalist view this does not reflect any essence of (negative) charge, but holds instead because a law of nature relates positive and negative charge (or more accurately governs charge in such a way that the force between opposite charges is attractive).

Typically the categoricalist holds that this state of affairs could have been different: in another possible world charge does not have this dispositional character, if the law does not hold in that world. Had Coulomb's law been different, negative charges might have been disposed to repel positive charges, or some other relation may have held between them. Thus the categoricalist holds:

> (CL) The laws are metaphysically contingent relations among categorical properties.[67]

As mentioned, there are two views about laws that fit with (C), PROPERTIES, and (CL). The first of these is the regularity view. On a regularity view of laws a law is some sort of regularity among the instantiations of properties. Thus all laws are general facts of the form: all instances of the property F are instances of the property G: $\forall x(Fx \rightarrow Gx)$; or in a slightly more complex case, whenever both property S and property P are instantiated, then property M is instantiated: $\forall x((Px \& Sx) \rightarrow Mx)$. On anything but a naive regularity theory, being a general truth, a regularity, is a necessary but not a sufficient condition of being a law of nature. Some distinction between laws and regularities is required in order to distinguish laws from merely accidental regularities. While earlier logical empiricist philosophers tended to make the distinction using an additional condition that was often epistemic (e.g. laws are well-confirmed regularities), the account now regarded as the best exposition of the regularity view is David Lewis's systematic regularity theory, summarized thus:

> A contingent generalization is a law of nature if and only if it appears as a theorem (or axiom) in each true deductive system that achieves a best combination of simplicity and strength (Lewis 1973: 73).

where the systems in question are those that systematize all the particular, local facts concerning the world. An important feature of Lewis's systematic regularity theory is

[67] Whether (CL) is entailed by (C) is unclear. One could hold that the laws of nature are metaphysically necessary, which would give categorical properties a necessary dispositional character. But this need not be equivalent to (DM) since something may have some feature necessarily without that feature being essential. However, that would leave unanswered the question of the source of the relevant metaphysical necessity. Although Evan Fales (1990) seems to come close to a view of this kind, I shall take it that categoricalism involves commitment to (CL).

that the laws in a world supervene on the arrangement of particular local facts; fix the latter, and the laws are fixed as a result.

If $\forall x(Fx \rightarrow Gx)$ and $\forall x((Px \& Sx) \rightarrow Mx)$ are laws on the regularity view, then (according to the regularity theorist) we have explanations for the truth of subjunctive conditionals. The first law makes it true that were **a** F, then **a** would be G; the second makes it true that given that **b** is P, were **b** S, then **b** would be M. The latter also allows us to say (to a first approximation) what a disposition is, according to a regularity theorist. It is a property (such as P in the last example) that occurs in the antecedent of a law in conjunction with some other property (S), the stimulus property, where the consequent (M) in the law is the manifestation property. Holding to (CL), regularity theorists hold that the regularities in question might not have held; in other possible worlds they do not. Hence in some other possible world, $\forall x((Px \& Sx) \rightarrow Mx)$ need not be true. In such a world, it might be the case that, for example $\forall x((Px \& Gx) \rightarrow Fx)$. While in the actual world the property P bears a special relation to the conditional $(Sx \,\Box\!\!\rightarrow Mx)$, in this other world it bears that relation not to this conditional but to a different one, $(Gx \,\Box\!\!\rightarrow Fx)$. Since the same property may in different worlds be associated with different conditionals, the relation it actually has with any particular conditional and hence the dispositional character it actually has are contingent. Thus regularity theorists deny dispositional essentialism.

We may summarize the regularity view of laws thus:

> LAWS_R Laws of nature are a subset of the contingent regularities (true generalizations) of the actual world. The subset is characterized by some further condition, such as the requirement that to be a law a generalization must be derivable from each optimal axiomatized system. In the latter case, the laws supervene on the particular facts—the facts comprised of individuals instantiating first-order universals. Laws entail universal generalizations, but are not entailed by them. Being contingent, there are worlds in which a law of the actual world fails. For example if $\forall x(Fx \rightarrow Gx)$ is a law of the actual world, there are other worlds where some **a** is F but not G, and which thus lack the law $\forall x(Fx \rightarrow Gx)$.

Dispositional essentialism is also denied by the second of the established categoricalist views of laws, traditionally regarded as the main opponent of the regularity theory, namely the nomic necessitation theory. David Armstrong (1983), for example, understands laws as second-order relations of 'nomic necessitation' among universals.[68] So the laws are not $\forall x(Fx \rightarrow Gx)$ and $\forall x((Px \& Sx) \rightarrow Mx)$, but are N(F,G) and N((P&S),M). Here 'N' stands for a relation among the universals in question.[69] Fred

[68] I note in passing the following advantage for the dispositional essentialist view over Armstrong's view. Armstrong (1978*b*: 44) prefers to think that all universals have a causal or nomic character. But his metaphysics gives us no reason to believe this, since universals do not depend upon laws for their existence (the dependence is the other way around). Armstrong does mention that we could never *know* of the existence of a non-causal universal but recognizes that this is at best a pragmatic justification for ignoring non-causal universals. The dispositional essentialist can provide an argument for Armstrong's claim since potencies have a dispositional role essentially.

[69] Armstrong (1997: 228-9) does register some dissatisfaction with this notation.

Dretske (1977) and Michael Tooley (1977) regard N as somehow conferring a kind of necessitation on those universals. The idea is that this necessitation leads to the regularity holding among instances of the universals. If N(F,G) is a law and **a** is F, then thanks to N, **a** must also be G—and similarly for any other thing which is F. Hence all Fs are Gs.

Thus the nomic necessitation theorist's view of laws is very different from the regularity theorist's. Laws involve a crucial element that is not employed by the regularity theorist, namely one (or more) second-order relations of necessitation. Nonetheless, Armstrong does agree with the regularity theorist that the laws, whatever they are, are contingent. In his metaphysics the relation of nomic necessitation, its name notwithstanding, might hold between certain universals in this world but not between those universals in another possible world. Thus Armstrong's understanding of dispositions is that they are properties such as P where in the world in question there is a law N((P&S),M). Thus in the actual world P may be associated with the conditional 'were *x* to be S it would become M', but because the relation of necessitation may not hold in some other world, D will not be associated with that conditional in all worlds. Correspondingly, in the actual world , P has the dispositional character $D_{(S,M)}$; nonetheless in some other possible world P may not have that character.

The nomic necessitation view of laws may be summarized thus:

> LAWS$_N$ Laws of nature are contingent relations among natural properties. If F and G are first-order universals, then a law relating them is the fact of a certain second-order universal relating F and G. We may call that second-order relation 'N', so that the law may be symbolized N(F,G). N has certain properties. For example: N(F,G) entails $\forall x(Fx \rightarrow Gx)$. Let us call the relation between F and G that holds whenever $\forall x(Fx \rightarrow Gx)$ the 'extensional inclusion relation', symbolized thus R(F,G). Thus N(F,G) entails R(F,G). However, R(F,G) does not entail N(F,G), since the relation of necessitation is not the same as nor coextensional with the relation of extensional inclusion. This is clear because there may be accidentally true generalizations without any corresponding law.

PROPERTIES and LAWS$_R$ and LAWS$_N$ are clearly not entirely independent. PROPERTIES itself requires that laws of nature be contingent. Otherwise a property engaged in a necessary law would thereby have a non-trivial modal character, that conferred by the law.

4.2 What is wrong with categoricalism about properties

4.2.1 *Quidditism*

In Chapter 3 I articulated the view of laws that flows from taking properties to have dispositional essences. I shall now argue that this dispositionalist view of properties has advantages over the categoricalist view. If the arguments are good, then there is something wrong with any property being a categorical property. In which case we have a reason to reject both (CM) and (MV).

In articulating (CM) and PROPERTIES and the two view of laws, LAWS_R and LAWS_N, I adverted to the fact that for both regularity theorists of law and nomic necessitarians, the nomic (and causal, etc.) features of a universal are contingent. If we allow one and the same universal to appear in distinct possible worlds, then, as Black (2000) notes, the view of universals expressed by PROPERTIES is akin to haecceitism about particulars. I shall regard the core of haecceitism to be the view that the transworld identity of particulars does not supervene on their qualitative features.[70] Black calls haecceitism about universals 'quidditism', which he takes to be 'the acceptance of primitive identity between fundamental qualities across possible worlds'. By 'primitive' we mean an identity that is not dependent on identity of nomic or causal roles or powers more generally. (Henceforth I shall refer to the causal powers and dispositional features associated with a property as its 'powers'.[71] Roughly, the powers of a property are the dispositions conferred on an object by possessing that property.) Although Black discusses quidditism with regard to Lewis's metaphysics, we should note that Armstrong is equally committed to quidditism. Whatever powers a property has, it has contingently as a consequence of the contingent laws in which it is involved. There is equally little to the essential nature of a property on Armstrong's view as there is on Lewis's. For both, properties are all categorical. In Chapter 1 I described Lewis's metaphysics as fully Humean and Armstrong's as semi-Humean. The adoption of the categorical monism is the respect in which they are both 'Humean'.

It is useful to distinguish here various elements to quidditism. First, says Black, according to the quidditist, fundamental properties do not have essential powers. I shall liberalize this to say that such properties do not have any powers of necessity.

(QA1) For all fundamental universals F and powers X there is a world where F lacks X.

Now let us consider a world w_1 where F does have X. (QA1) tell us that there is some world where F lacks X. Because we are dealing with fundamental universals, we can say that the nearest possible world where F lacks X is one which is in fundamental respects just like w_1, except that F lacks X. (If we were dealing with differences at a non-fundamental level, then we could not say this.) For example, in Lewis's view the nearest such world will be one where the regularity which relates F, the stimulus property of the power S, and the manifestation property M, will not hold—there will be one exception. In Armstrong's view F will not be related by contingent nomic necessitation, N, to S and M. These changes can be made leaving all other fundamental features of the world intact.

[70] Where 'qualitative features' are taken to exclude properties involving identity.

[71] I do not call them *causal* powers for two reasons. First, I do not want to give the impression that the notion 'causal power' is to be analysed in terms of causation. If anything the relationship is the reverse. Secondly, it may turn out that causation is only a macro-level phenomenon, but that powers exist at the fundamental level. An additional point: there are no causal or other powers independent of laws/dispositions. While singularists about causation might think that a particular has its causal powers independently of law, it is difficult to see how a universal could have or confer causal powers without generating what we would naturally think of as a law.

(QA2) For any world w_1, any fundamental universal F, and any power X, where at w_1, universal F has X, there is a world w_2 like w_1 in all fundamental respects except that the very same universal F lacks X.

If a universal can lose a power with ease, it can also gain one. Categorical properties are all essentially alike—differing only in their mutual distinctness. So if one categorical property can have a certain power, so can another, in some world. Given that in w_1 F lacks X, what is the nearest world in which F possesses X? It will be just like w_1, except that (i) F possesses X and (ii) F loses any powers possessed in w_1 that are incompatible with F's possessing X. Thus:

(QA3) For any world w_1, any fundamental universal F, and any power X, where at w_1, universal F lacks X, there is a world w_2 like w_1 in all fundamental respects except (i) that very same universal F possesses X, and (ii) F does not possess any powers inconsistent with X.

(DM) states that fundamental universals do have essential powers, and hence (DM) $\Rightarrow \neg$(QA1) (and (DM) $\Rightarrow \neg$(QA2) and (DM) $\Rightarrow \neg$(QA3)). Since both (DM) and (QA1) are claims about *all* fundamental properties, the denials of both are consistent with one another—if one denies both one holds (MV), the view that some fundamental properties have dispositional essences and others do not.

However, if as I suggested for laws, we adopt as an assumption of the debate that we should give a unified account of the metaphysics of fundamental properties (one that ascribes the same modal character to all—either all have dispositional essences or none have) then (DM) $\Leftrightarrow \neg$(QA1).

Secondly we may adopt the analogue of the core of haecceitism as I defined it above: the transworld identity of universals does not supervene on their qualitative properties, where now 'qualitative' means powers.

(QB1) Two distinct worlds, w_3 and w_4, may be alike in all respects except that: (i) at w_3, universal F has powers $\{C_1, C_2, \ldots\}$; (ii) at w_4, universal G has powers $\{C_1, C_2, \ldots\}$; (iii) F$\neq$G.

(QB1) captures the idea that sameness of powers does not entail identity of universals. Strictly this is consistent with dispositional essentialism. The fact that one property has its powers necessarily is consistent with some distinct property having those same powers (also necessarily).[72] However, just as essentialism aims to give an account of what laws are, it may also aim to account for the nature and identity of, at least, fundamental properties. That is, not only are the powers of a property essential to that property, they are the essence of the property—they constitute what it is to be that property. Thus identity of powers entails identity of property. This view I shall call strong dispositional monism (SDM). The difference between (henceforth weak) dispositional monism and strong dispositional monism is captured in Black's statement of what Lewis and Hume deny, 'that fundamental properties have,

[72] Thus John Hawthorne (2006: 212) identifies what he called the 'double aspect view', which he associates with William of Ockham. A property's powers are essential to it but do not exhaust its nature. A quiddity is also required to identify a property.

let alone consist of, essential powers'. The denial of *having* essential powers is the denial of weak dispositional monism, and the denial of *consisting of* essential powers is the denial of strong dispositional monism. Thus (SDM) = (DM) + ¬(QB1). Strong dispositional monism makes the identity of fundamental properties require identity of powers. The further claim that (SDM) makes over (DM) is pretty well what Shoemaker (1980: 212) famously argues for in 'Causality and Properties', where he says, 'what makes a property the property it is, what determines its identity, is its potential for contributing to the powers of things that have it . . . if under all possible circumstances properties X and Y make the same contribution to the powers of the things that have them, X and Y are the same property.'

In this discussion I have been careful to distinguish (QA1) and (QB1). However, as we shall see, (QA1) in fact entails (QB1), via (QA2) and (QA3). (Note, nonetheless, that because the negation of (QA1) does not entail the negation of (QB1), weak and strong dispositional monism are still distinct.)

4.2.2 *Against quidditism—(QA1)*

Haecceitism is discussed, and rejected, by Roderick Chisholm (1967). Chisholm considers changes to the properties of two individuals, Adam and Noah, in a sequence of possible worlds, so that at each change from one world to the next we are, it is supposed, happy to say that the change in properties does not change the identities of the individuals. We then find that in the final world Adam has all the properties Noah has in the actual world, and vice versa (including the names people call them). The transitivity of identity requires that the final world is distinct from the actual world. But Chisholm takes it to be absurd that there should be a world like this that is not the actual world. If he is right, then haecceitism is false. He draws a disjunctive conclusion, that either there are essential properties (we were wrong to assume that every change of property across worlds leaves identity intact), or transworld identity of particulars is misconceived. Since he has what he takes to be reasons for thinking that essential properties are absurd, he adopts the second disjunct. This is of course Lewis's view about particulars, which each exist only in one world but may have counterparts in others. Interestingly Lewis does not reject transworld identity for universals—and the force of Black's argument against Lewis is that Lewis cannot both be a genuine (or concrete as opposed to ersatz or mathematical) modal realizt while remaining a quidditist, someone who allows for transworld identity of Humean properties. Black raises counterparts for properties as one option for Lewis (not Black's preferred option). However, this is not the only option, even for genuine modal realizts. It is my view that Chisholm should have accepted that individuals have essential properties. I shall argue that we should accept that analogous view of properties, that they have essential powers.

It may be noted that Chisholm's argument is not against the core of haecceitism as I defined it—that the transworld identity of particulars does not supervene on their qualitative features. Rather it is against the following:

> (H0) Two distinct worlds, w_1 and w_2, may be alike in all respects except that:

(i) at w_1, particular **a** has qualities F_1, F_2, F_3 ... and particular **b** has qualities G_1, G_2, G_3 ...;
(ii) at w_2, the particular **a** has qualities G_1, G_2, G_3 ... and particular **b** has qualities F_1, F_2, F_3 ...;
(iii) $\forall i \, \forall j \, (F_i \neq G_j)$.

(H0) is a substantial claim. The simplest expression of haecceitism is that particulars lack essential properties. (In what follows 'properties' are limited to intrinsic properties that not all particulars have of necessity (i.e. not self-identity, not the property such that 2+2=4, etc.). Thus:

(H1) For any particular **a** and any property F there is a world where **a** lacks F.

which corresponds to (QA1). Just as (QA1) leads to (QA2) and (QA3), (H1) leads to:

(H2) For any world w_1, any particular **a**, and any property F, where at w_1, **a** has F there is a world w_2 like w_1 in all respects except that **a** lacks X.

(H3) For any world w_1, any particular **a**, and any property F, where at w_1, **a** lacks F, there is a world w_2 like w_1 in all respects except (i) that **a** is F, and (ii) **a** does not possess any properties inconsistent with X.

Put less formally, the haecceitist conception of particulars is that they are essentially all alike, differing only in that they are mutually distinct. Identity is independent of qualities in a very strong sense. Any property a particular has it could lack and any it does not have it could possess; in general any particular may possess or lack any consistent set of qualities. Is Chisholm correct in ascribing (H0) to the haecceitist? I think he is. Since all particulars are essentially alike, it is possible for one to possess all the properties of another and vice versa. Furthermore, Chisholm provides a story about how we get to (H0) via repeated applications of (H2) and (H3). Neighbouring worlds differ only as regards the lack/possession of a single quality.

As mentioned, (H2) and (H3) are the haecceitist analogues of the quidditist (QA2) and (QA3). Correspondingly, quidditism is committed to the truth of:

(QA0) Two distinct worlds, w_1 and w_2, may be alike in all respects except that:
(i) at w_1, universal F has powers X_1, X_2, X_3 ... and universal G has powers Y_1, Y_2, Y_3 ...;
(ii) at w_2, the universal F has powers Y_1, Y_2, Y_3 ... and universal G has powers X_1, X_2, X_3 ...;
(iii) $\forall i \, \forall j \, (X_i \neq Y_j)$.

This seems right. If, as Black says, the quidditist conception of properties is that they have primitive identity, identity that is completely independent of their powers, then there should be no reason why we cannot swap powers without swapping universals—or swap universals without swapping powers.

Now consider the following descriptions of worlds:

w_a The actual world (assuming a Newtonian account of the laws of nature).

w_b Like w_a, except there is no negative charge.

w_c Like w_b, except that (i) inertial mass is not proportional to gravitational mass; and (ii) inertial mass is proportional to charge.

w_d Like w_c, except that there is negative gravitational mass (Newton's law of gravitation still holds, so a negative mass and a positive mass repel).

w_e Like w_d, except that the signs in Newton's law of gravitation and Coulomb's law are both changed. (Thus two positive charges attract; two positive gravitational masses repel; a positive and a negative gravitational mass attract.)

The world w_e is one where charge has all the causal or nomic roles associated with gravitational mass, including proportionality with inertial mass, while gravitational mass has the causal/nomic roles of charge. We can also describe a world w_f like the actual world except that the roles of gravitational mass and inertial mass have been swapped. Consequently we can also describe a world w_g like the actual world except that the roles of charge and inertial mass have been swapped.

The worlds w_e, w_f, and w_g are analogues for properties of Chisholm's final world with every property of Adam and Noah swapped. Just as Chisholm wants to say about Noah and Adam, if anything exists which seems to fit our description of w_e, then it is just the actual world plus a decision to swap the names 'gravitational mass' and 'charge'; similarly if anything exists which seems to fit our description of w_g, then it is just the actual world plus a decision to swap the names 'inertial mass' and 'charge'. Indeed, I think our intuitions tell us that there is something wrong about worlds w_b to w_d as well.

Just as we should reject haecceitism we should reject quidditism, which we may do by allowing both particulars and properties to have essential properties.[73] Chisholm does not go down this road for particulars, for two reasons. First, he thinks that we would have no way of knowing what the essential properties are. Secondly, he thinks that the essentialist would be committed to the view that knowing, for example, who the bank robber is would require knowing of some x, whose essential properties are E, that x has E and x robbed the bank. But neither of these are good grounds for doubting essentialism. To the first one may make two replies. First, if we are to believe Kripke, we do know what an individual person's essential properties are (or at least include), and that is a matter of coming from some particular egg and sperm. Secondly, whether or not Kripke is right, our ignorance of which the essential properties are is not itself a strong reason for doubting the coherence of the view that says that they exist. Turning to the second problem, the issue of essential properties, in this context, is a matter of transworld identity. Presumably the detective is interested in capturing the criminal in this world, not in tracking him down in some

[73] Mumford (2004: 103-4, 151-2) and Kistler (2002: 69) reject quidditism on this ground also.

other world. Therefore knowledge of *contingent* properties that enable the detective to pick the robber out from other *actual* people is all that is required.

Essentialism thus seems a good bet for delivering us from haecceitism about individuals. And it is equally serviceable for avoiding quidditism about properties. If inertial mass, charge, and so forth are qualities that confer the powers that they do necessarily, then the descriptions of worlds w_b to w_g do not describe genuine possibilities. The Chisholmian intuitions that lead us to reject those putative possible worlds can only encourage us to reject strong quidditism.

4.2.3 *Against quidditism—(QB1)*

Assuming a uniform metaphysics of properties, rejecting (QA1) is the same as accepting weak dispositional monism, (DM). But (DM) is compatible with (QB1). (QB1) allows that the essential properties of a property may not be enough to establish its identity—two properties may have the same essential powers.

What then might inspire us to make the transition to (SDM) from (DM)? Equivalently, what reason is there to adopt the Shoemaker line about properties, that their powers establish their identity?

Consider:

> (QB2) One and the same world *w* is such that: (i) at *w*, universal F has powers $\{C_1, C_2, \ldots\}$; (ii) at *w*, universal G has powers $\{C_1, C_2, \ldots\}$; (iii) F≠G.

(QB2) differs from (QB1) in that whereas (QB1) contemplates distinct worlds where distinct properties have the same powers, (QB2) allows a single world to contain distinct properties with the same powers. Despite this difference, I believe that (QB2) is implied by the quidditist picture. If identity is independent of powers, why shouldn't two properties possess the same powers in the same world? Furthermore it looks as if we can get to (QB2) by iterated applications of (QB1), in a manner similar to the Chisholm strategy. In Chisholm's original story, we considered swapping the qualities of Adam and Noah one by one. But if instead we considered just half this story, the changes that happen to Noah, so gradually Noah loses his own properties and acquires Adam's, without Adam undergoing any change, then we will end up with two particulars, Adam and Noah in the same world with identical qualities. The same strategy applied to properties gives us (QB2). (QA1), thanks to its implications in (QA2) and (QA3), allows the loss and gain of powers quite without consideration of whether those powers are possessed by any other property. *A fortiori* (QA1) permits us to start with a world where F has powers $\{C_1, C_2, \ldots\}$ whereas G does not, and for G to lose and gain powers until we end up with a world where G has powers $\{C_1, C_2, \ldots\}$ without considering the existence of a distinct F with those same powers. The same argument shows how (QA1) yields worlds as described by (QB1).

(QB2) envisages two properties entering into entirely parallel causal roles and nomic relations. I.e. let F and G be properties, and let it be the case that for every other property H, it is a law that Fs are Hs iff it is a law that Gs are Hs, and so on. If this were the case, then F and G would be indistinguishable—where there seemed to be one law there would in fact be two. Applied to the case of inertial mass, the idea is that there might be two fundamental properties that are actually responsible for its being

such that if a force is applied then a corresponding acceleration would result, mass_A and mass_B. If something accelerates with acceleration a when subjected to force F, there would be two potential explanations for this, that the entity has mass_A equal in magnitude to F/a or that it has mass_B equal to that magnitude. If weak quidditism were correct we would not know whether we are in such a world or not, or indeed in such a world there are many, many parallel properties, each of which is possessed by exactly one bearer.

The forgoing consequence of (QB2), adverted to by Shoemaker (1984: 215), does serious damage to our concept of property. Nonetheless, at first sight, a categoricalist might be able to bite this bullet. But they should contemplate a more obviously troubling difficulty thereby created for our understanding of dispositional and theoretical terms. For example, Prior (1985: 64) suggests two ways a categoricalist might understand 'inertial mass': inertial mass = the property responsible for being such that if a force were applied then a finite acceleration would result; or, inertial mass = the property *actually* responsible for being such that if a force were applied then a finite acceleration would result. The first proposal is that 'inertial mass' stands for a definite description, while on the second 'inertial mass' is a rigid designator that picks out at a possible world precisely that property that in the *actual* world has the relevant kinematic effects. As far as I can tell, Armstrong regards the second or something like it as the appropriate understanding. Now consider a world as described where two distinct properties both do the same causal work of responding to a force with an acceleration. Then the term 'inertial mass' would fail to refer, on both glosses.

Similarly, Lewis (1970) explicates theoretical terms by elaborating on the idea of a Ramsey sentence. The Ramsey sentence of a theory $T(t_1, t_2, t_3, \ldots t_n)$, which contains the theoretical terms $t_1, t_2, t_3, \ldots t_n$, is the sentence $\exists x_1 \exists x_2 \exists x_3 \ldots \exists x_n\, T(x_1, x_2, x_3, \ldots x_n)$. Lewis's idea is that we regard the terms $t_1, t_2, t_3, \ldots t_n$ as referring only if the open sentence $T(x_1, x_2, x_3, \ldots x_n)$ is uniquely satisfied. If the latter is the case then the term t_i refers to the entity e_i in the unique n-tuple $<e_1, e_2, e_3, \ldots e_n>$ that satisfies $T(x_1, x_2, x_3, \ldots x_n)$. In a world where there are parallel properties, both of which stand in the relation T to other properties, there will be failure of reference of the corresponding theoretical terms. The possibility of reference-failure of theoretical terms is not itself a problem—we know this possibility to be actualized in some cases. What is worrying is the thought that we can never know that the possibility is not actualized for any theoretical term—we never know whether any such term refers.

It appears that Lewis (2001) later changed his mind to regard cases of multiple realization as involving indeterminate reference. I am not sure what indeterminate reference is. The law of the excluded middle requires that either t refers to e or t does not refer to e. In any case we are still left in the position of never knowing whether our theoretical terms (determinately) refer. Lewis says that the original injunction to regard reference as failing in the case of multiple realization was supposed to meet the intention of the theorist to give an implicit definition of his terms. That may be the intention of the theorist. What is clearer is that the theorist intended to refer (determinately). For if the theorist had intended to leave open the possibility of multiple realization, the theorist would not have used a theoretical term (a referring expres-

sion) but instead would have used quantifiers (as in the Ramsey sentence). Put another way, the proper Ramsey sentence for $T(t)$ is not $\exists x T(x)$ at all but rather $\exists! x T(x)$. Lewis seems to concur, saying that we should write the postulate in such a way that the theory cannot be multiply realized. If we do that, we have no way of knowing whether our theory is true or not, since we have no way of knowing that it is not multiply realized by functionally parallel but categorically distinct properties. Lewis accepts and indeed argues for the thesis that quidditism entails Humility, where Humility is the claim that we cannot know about the fundamental properties of nature. Lewis may have been content to accept both quidditism and Humility. But *this* sceptical consequence of Humility is, I suggest, a very high price to pay for the Humean metaphysic.

We do not want our metaphysics of properties to condemn us to necessary ignorance of them. And so we should reject quidditism. Since categoricalism entails quidditism (strong and weak), we should reject categoricalism too. The problems concerning identity and reference raised by quidditism are immediately resolved by adopting strong dispositional essentialism, the view that the identity of properties is fixed by their essential powers.

Before concluding this discussion of the sceptical consequences of quidditism, I should note that Jonathan Schaffer (2005) rejects sceptical arguments against quidditism on the ground that the problems they raise are no different from more familiar sceptical worries, and may be answered using the same kinds of response. There is no especially intractable sceptical problem for quidditism. Schaffer presents a very important challenge to those who would reject quidditism on sceptical grounds. That said, I do not believe that his challenge is a compelling answer to the sceptical problem I have identified, which is different from the one he discusses.

The sceptical problem Schaffer aims to deflate arises from consideration of the swapping of powers that (QA0) envisages. Schaffer (2005: 16) summarizes quidditistic scepticism thus:

> (QS) If there are worlds that differ solely over which property confers which power, then we do not know which properties exist.

I agree with Schaffer that this is a poor sceptical argument, but I also think that it can be dealt with very straightforwardly. Let Q be the categorical property that in fact possesses some familiar power in the actual world, say charge. Q possesses the charge power in the actual world, though in some other, indistinguishable world Q possesses the inertial mass power, and it is R that has the charge power. Can we in the actual world know that Q exists? Of course. We know that there is a charge power, and we know that some property possesses that power. The term, 'the property which possesses the charge power' refers to Q. We can give the referent a name, say 'Q'. And we know, thanks to science, the truth of 'the property which possesses the charge power exists', and so we know the truth of 'Q exists'. What more could be required to know which properties exist?

The defender of (QS) might complain that this knowledge is somehow incomplete, because we know Q only via a description or via Q's contingent effects; we do

not know *Q*'s essence. But, as urged against Chisholm in Section 4.2.2, to know *x* does not require knowing *x*'s essence. Many people know water, know that it exists, and know lots about it, without knowing its essence. That is why I do not run a sceptical argument in Section 4.2.2 where I raise the power-swapping issue. I regard power swapping to be counterintuitive enough on its own, but I do not think it has sceptical consequences.

My own sceptical argument is different. It focuses on the denial of (QB1) and (QB2) and so envisages a world in which properties are duplicated. If properties were duplicated then the answer given in the preceding paragraph but one would not be available. The term 'the property which possesses the charge power' would not pick out any property, the name '*Q*' would be empty, and '*Q* exists' would not even be true let alone knowable. Might Schaffer be right nonetheless, that the responses given to familiar sceptical arguments could be applied here? The matter is far from clear. Consider the Brain in a Vat scenario. It is alleged that your experiences would be the same in the good world (the world as you like to think it is, with no brains in vats) and the bad world (where you are a brain in a vat). A standard component of an externalist response is to say that if the actual world is in fact a good world, then the bad (brain in vat) world is such a distant possible world that ignoring it is sufficiently reliable for the purposes of knowledge. Knowledge requires only that what is known is true in close worlds, not in all worlds. How about worlds with duplicate properties (distinct properties sharing the same powers)? Are they distant from a world with just one property per power? It is difficult to say. I am inclined to think that the categoricalist has such a thin conception of properties that the addition of duplicate properties would make for only minor differences between worlds. But I do concede that it is difficult to see what kind of argument would settle the matter one way or the other. It nonetheless remains an advantage for dispositional essentialism that the question does not arise.

4.2.3.1 *Structural properties* One objection to dispositional essentialism concerns geometrical, numerical, spatial, temporal properties, and other properties that I call 'structural'. The objection is that while other properties have dispositional essences, it is difficult to see that these ones do. On the other hand we cannot just ignore such properties, for they do play a part in scientific explanations. A cylinder can be made to roll down an inclined plane of less than 45 degrees but a triangular or square prism cannot. It is the shape of the cross-sections that explains such facts. The law of gravitation tells us how gravitational force depends on spatial separation. And so on. If the fundamental properties of science include such properties then, it seems, some fundamental properties are categorical.

I devote Chapter 7 to arguing that structural properties provide no counterexamples to (DM). Here I want to consider whether the objection to categorical properties raised immediately above can somehow be avoided for these properties. Here is a suggestion. The problem arises for property terms which are introduced by a description of their theoretical role. But not all properties need be introduced that way. For example, we can understand 'triangle' via a definition ('plane figure with three

straight edges'). Or we can understand the same term via direct ostension of triangles. Similarly we can fix a standard of spatial displacement (distance) with a sample (a ruler or standard measure). These might be direct ways of relating to categorical properties, as contrasted with the indirect route via a role in a scientific theory or explanation.

This perspective is, however, misleading, for various reasons. First, the claims of dispositional essentialism are intended to apply only to fundamental properties. And there is no reason to suppose that properties identified in the manners described will be ones that appear in fundamental science (the ostensive definition of spatial and temporal quantities may appear to be an exception; I shall return to these). In particular we should not expect composite properties, those defined in terms of a composition of parts (such as triangle) to figure in fundamental science. Secondly, we have no guarantee that the methods under discussion (ostension and definition) will pick out genuine natural properties, fundamental or not. Let us consider a parallel case, the ostension of natural kinds of substance. We may be able to define a natural kind term (e.g. 'gold') by ostension. But *a posteriori* investigation is required to establish that we have successfully done so. If the ostended sample is not a single substance but a mixture, then we will not have defined a kind term. Furthermore, the distinction between mixtures and compounds, which is required to ground the ostension of many chemical natural kinds, is itself a product of chemical theory. Thus ostension cannot bypass theory in the definition of kind terms. Nor can it do so for property terms. One might have thought, nonetheless, that if there is a single kind being ostended, then one has succeeded in picking out that kind rather than some functionally parallel kind. However, it is not merely a simplification to think of ostensive definition as being a single event. There is no single sample of gold that fixes the extension of the term 'gold'. We multiply and repeatedly characterize that extension via acts of ostension. Our ability to do so depends on it being the case that most of the samples are indeed instances of the same substance. That can be confirmed by empirical investigation, and again that will depend on the employment of a relevant theory. In some cases we may find out that the samples are not all the same, as in the case of 'jade', and that we have not picked out a natural kind. In such cases we can find out whether we have we have succeeded (or failed) in characterizing a kind by investigation of the structure and composition of the samples. But in the case of fundamental properties that is just what we cannot do.

Let us turn to spatial and temporal properties, These might well seem to be quantities that we can define ostensively and which appear in fundamental physical theory but do not themselves have an essentially dispositional character. Again there is no guarantee that the macro-quantities are related to fundamental micro-quantities just by 'scaling-down'. The more we discover about space and time as revealed by basic physics, the less it resembles the three more-or-less Euclidean spatial dimensions and one temporal dimension that the macro-world appears to occupy. Indeed spacetime might not be a fundamental entity at all and hence measures of space and time might not be fundamental either. (Compare the temperature of a gas, which is a macro-quantity that has no corresponding micro-quantity.) Nor can we assume,

therefore, even if there are fundamental spatial and temporal quantities, that these are the same as the macro-quantities. Again, it is a matter of scientific discovery whether this is so. Consequently the terms that a fundamental theory would employ to name such quantities will be theoretical terms. Hence the problems raised for categorical properties will apply to these properties also. More generally, it is a mistake to think that we are acquainted with any natural property as they are independently of their causal powers, since if we know about a property at all it is via its effect on us. As Marc Lange (2002: 87) puts it 'Geometric properties, like size and shape, may initially seem to be ideal cases of properties we know in themselves. But insofar as these are physical properties, to be instantiated by matter in space and not merely by abstract mathematical entities, it is not obvious that our senses disclose to us these properties as such.' Lange's remark may also help us see why it does not help that we think we can grasp 'triangle' simply through its definition as a 'plane figure with three straight edges'. The possibility of abstract definition does not show that we have defined a property that we can know, independently of any theory, that it is physically possible for some object to possess. Thus if spatial and temporal properties were categorical they would be caught by Humility also. But if they are potencies also, we do not need to countenance such a sceptical conclusion.

4.3 What is wrong with categoricalism about laws—regularity

There are two well-known accounts of law that adopt a categoricalist view of properties, and hence may be regarded as categoricalist accounts of law. These I have mentioned above—the regularity view of laws, Lewis's best system account in particular, and the nomic necessitation view, promoted by Armstrong, Dretske, and Tooley. In this section and the next I shall argue that the categoricalist accounts of law fail. A great deal has been written about these accounts, which have been taken until recently to be the main metaphysical rivals. I do not intend to cover all that ground again. Rather, in this section I shall briefly outline what I take to be the main problems with the regularity view and then move on in the next section to what I take to be the ultimate argument against the nomic necessitation view.

4.3.1 *The regularity view of laws and Humean Supervenience*

Strictly a regularity view of laws need not require categorical properties nor be inconsistent with dispositional essentialism. Indeed so far I have implied something like a regularity view when in Chapter 3 I identified laws as certain kinds of regularity—laws are those regularities which hold as a consequence of the essentially dispositional nature of fundamental properties. I shall enlarge upon this view below, in Chapter 9.

Nonetheless, what has traditionally been referred to as the Regularity Theory of Laws has taken it that there is nothing metaphysically deeper or more substantial from which laws flow. Rather laws are no more than regularities that also meet some further, metaphysically innocuous, condition. That further condition might, for example, be an epistemic condition; so laws are regularities such that hypotheses concerning them have some degree of inductive support. A more important proposal for the additional condition is that laws are regularities that can be suitably system-

atized. Underpinning this view, due in earlier versions to Mill and Ramsey and in its most developed form to David Lewis, is Humean Supervenience, the doctrine that:

> (HS) All there is in the world is a vast mosaic of local matters of particular fact, just one little thing and then another (Lewis 1986*c*: ix).

As applied to laws, we may take the doctrine to be:

> (HS_L) The laws of the world supervene on the totality of local matters of particular fact.

A 'local matter of particular fact' is a matter of an object possessing a categorical property, so laws in particular supervene on the instantiation of categorical properties. Thus we understand (HS_L) as asserting:

> (HS_L)^C The laws of the world supervene on the totality of instantiations of categorical properties.

(HS_L) needs to be understood in such terms if it is to stand clearly as a point of difference from the dispositional essentialist view. For if one understands (HS_L) thus:

> (HS_L)^P The laws of the world supervene on the totality of the instantiations of potencies.

then the dispositional essentialist will have little to disagree with. As we have seen, the laws of a world depend and so supervene on the potencies (i.e., the universals or properties) that exist at a world. Let us restrict our attention to instantiated laws. In such a case the relevant potencies will be instantiated and exist. Those potencies will be the ones that give rise to that law. Hence two worlds in which the same potencies are instantiated will have the same instantiated laws. The only respect in which they might differ nomically is in uninstantiated laws. One world might have an uninstantiated potency and a resulting law where the other world lacks that potency—and law—altogether. So the dispositional essentialist may quarrel with (HS_L)^P only with respect to uninstantiated laws. Furthermore, note that if one adopts strong necessitarianism (Section 3.2) then (HS_L)^P comes out as trivially true. Necessary truths supervene on anything whatsoever.

For this reason, the dispositional essentialist must be more circumspect in criticizing (HS_L) than some other opponents. John Carroll (1994), for example, has an objection to (HS_L) that aims to show that two worlds might be alike in their matters of particular fact but nonetheless have different laws. Here is a simplified version of Carroll's objection. Let us consider two worlds, U_1 and U_2. These have laws L_1 and L_2 respectively. L_1, operative in U_1, says that X-particles, when they enter a Y-field, go spin-*up*; L_2, operative in U_2, says that X-particles, when they enter a Y-field, go spin-*down*. In U_1 the Y-field exists in a certain experimental set-up only once and for a limited period; access to that region is controlled by a door, which is open, allowing the X-particles to enter the Y-field, and accordingly those particles have spin-up in the field. In U_2 the experimental set-up is just the same, with an open door and particles entering the Y-field, except that in this case the particles acquire spin-down.

Now we consider two further worlds, U_1* and U_2*. U_1* is just like U_1 in all respects, with the exception that before the Y-field comes into existence the door is closed and

FIG. 4.1. The world U_1

FIG. 4.2. The world U_2

remains closed thereafter, preventing any X-particles ever entering the Y-field. Analogously, U_2* is just like U_2 except that the door that is open in U_2 is closed in U_2*, also preventing the X-particles of U_2 ever entering its Y-field. Now we compare U_1* and U_2*. As regards matter of particular fact, the two worlds are just the same. U_1 and U_2 differed in matters of particular fact, since in U_1 X-particles entered the Y-field and were spin-up, whereas in U_2 the X-particles were spin-down in that field. But both in U_1* and in U_2* the doors were closed and no particles entered the field. So there were no spin-up nor spin-down particles differentiating the worlds. The matters of particular fact are the same. Now consider the laws of U_1* and U_2*. U_1* is like U_1 except for the closed door and its consequences. Hence it shares the laws of U_1, i.e. it has the law L_1. Analogously U_2* shares the laws of U_2, i.e. it has the law L_2. Thus we conclude that U_1* and U_2* are alike in matters of particular fact but differ with respect of their laws. And thus they constitute a counterexample to (HS_L).

The dispositional essentialist, however, cannot employ this argument in quite so straightforward a manner. For the dispositional essentialist must reject the starting

FIG. 4.3. The world U_1*

FIG. 4.4. The world U_2*

point, that there can be two worlds differing as U_1 and U_2 do. Carroll supposes that the same kind of particles and the same kind of field may be governed by differing laws of interaction, one yielding spin-up, in U_1, and the other yielding spin-down, in U_2. This assumes a contingentism about the laws of nature that the dispositional essentialist regards as mistaken. If the particles and fields are the same in the two worlds then they instantiate the same potencies and thus give rise to identical laws. If on the other hand the laws are different, then the properties of either the particles or the field must differ between U_1 and U_2. But then they will also differ between U_1* and U_2*, in which case we have no counterexample to (HS_L). (But note also that by the same token Carroll's argument cannot be taken as a counterexample to the regularity version of the dispositional essentialist approach to laws.)

The dispositional essentialist can, nevertheless, regard Carroll's argument as a *reductio* of the categoricalist regularity theory of laws, i.e. (HS_L), understood as a claim about categorical properties, viz. $(HS_L)^C$ plus the more specific claim that laws are regularities. That view regards worlds such as U_1 and U_2 as entirely possible, since it regards the laws as contingent. In U_1 there is the non-empty regularity that all X-particles are spin-up in Y-fields, and so U_1 has the law L_1. Similarly, the regularity theorist is committed to the possibility of U_2 with its law L_2. It seems then that the regularity theorist ought also to allow the existence of U_1* and U_2*. In which case the regularity theorist allows the existence of worlds that are a counterexample to $(HS_L)^C$. The only way that the regularity theorist can resist this line of argument is to deny that both (i) U_1* is like U_1 in respect of laws and (ii) U_2* is like U_2. Thus in at least one of these pairs, the difference that seems merely to be the closed door (and consequent lack of particles in the Y-field) in fact also leads to a difference in laws.

This response highlights a commitment that is already clearly present in $(HS_L)^C$. If the laws are contingent and supervene on the distribution of matters of particular fact, then altering (across worlds) the distribution of matters of particular fact ought on some occasions to alter the laws. In particular a law can be removed just by preventing certain interactions. This seems to be a damagingly absurd consequence of a theory of laws. Let us assume that the prevention of the interactions is not itself forbidden by the laws (and why should it be?). In that case, the difference between worlds that is allowing the interaction in one world and preventing it in the other, requires a change in the laws. How could that be?[74] Carroll's argument thus does not so much provide an explicit counterexample to $(HS_L)^C$ but instead highlights a counterintuitive commitment of that thesis.

Lest the categorical regularity theorist should wish to bite the bullet, the problem can be laid out more precisely. Non-fundamental laws depend on fundamental laws, in that one cannot change a non-fundamental law without changing some fundamental law. But each fundamental law is independent—one can change one fundamental law without changing the other. Let us imagine that in our examples the law concerning the opening or closing of the door is independent of the law concern-

[74]The dispositional essentialist is permitted also to regard this as absurd without self-contradiction, since all the relevant universals (e.g. being an X-particle, being a Y-field) are instantiated in all the worlds in question.

ing the X-particles (they may both be fundamental laws). We have considered U_1 in which the door law says that the door is open. Now let us consider a world U_1† whose history is just like U_1 until shortly before the X-particles come near the door and the Y-field behind it. U_1† differs from U_1 at this point in that the door is now closed, and consequently the particles do not enter the field. Since the door is closed in U_1† it contains a violation of the door law of U_1, i.e. it cannot have U_1's door law. But because the door law and the particle law are independent U_1† *can* have U_1's particle law (viz. L_1). By parallel reasoning there is an analogous U_2† that also has a closed door but also has U_2's particle law (viz. L_2). U_1† and U_2† have the same matters of particular fact but different laws. To avoid this counterexample to $(HS_L)^C$ the regularity theorist must claim that in one or other (or both) of these analogous cases, the change in the door law also involves a change in the particle law. But that violates the supposition that they are independent.

A supporter of Lewis might well respond that his version of the regularity theory says that laws are part of an integrated set of regularities that together optimally systematize the particular facts. And so on that view one should expect that changes to one part of the system, one law, might lead to changes elsewhere. However, the argument can be run without depending on the violation of any law. Let us imagine that the opening and closing of the door is controlled by a system driven by the slow radioactive decay of some substance. Imagine that at the time of the particles arriving at the door there is a 50 per cent chance of its being open. In U_1' the door is open, as in U_1 but in U_1'† the door is closed. But in this case the difference in the door represents no difference or violation of law—both open and closed doors are possible outcomes according to the probabilistic door law. Thus one cannot appeal to the systematicity of laws to argue that the transition from U_1' to U_1'† (a difference in the door *position* but not the door *law*) may be expected to involve a change in the particle law. On the contrary the laws of U_1', just before the arrival of the particles, dictate that there is a 50 per cent chance of the door being closed and so a 50 per cent chance of a future just like that of U_1'†. But a world with that future, i.e. U_1'† itself, cannot, according to the regularity theorist, on pain of violating $(HS_L)^C$, have the laws of U_1'. In effect the laws of U_1' dictate that there is a 50 per cent chance of a future which is itself inconsistent with those laws.

This objection is a variant on a well-known problem for Humean Supervenience. A probabilistic law ought to be compatible with a variety of possible developments of the world. Thus the law that Fs have a 0.5 chance of being G is compatible with 40 per cent of Fs being G. On the other hand the frequentist view of probabilistic laws requires that the world with 40 per cent of Fs that are G be a world where the law is that Fs have a 0.4 chance—*not* a 0.5 chance—of being G. This problem Lewis referred to as the 'big, bad bug' for Humean Supervenience (Lewis 1986*c*: p.xiv). Lewis does claim to have an answer to the big, bad bug problem. He amends his best-system analysis so that a third criterion is added to strength and simplicity, viz. fit. There is a good fit between a system and the actual course of history if that system accords it a higher chance than competing systems. Thus, when other things (strength and simplicity) are equal, the chances according to the probabilistic laws will equal the

actual frequencies. However, says Lewis, regarding a class of events that is not too large, '... suppose the frequency is close to some especially simple value—say, 50-50. Then the system that assigns uniform chances of 50% gains in simplicity at not too much cost in fit' (Lewis 1994: 481). There are problems with this however. An important constraint on simplicity, as regards the deterministic best-system analysis, is that the laws should refer to natural (sparse) properties. Thus false apparent simplicity may not be generated by the substitution of a simple, gerrymandered predicate in place of a complex concatenation of natural predicates. But I do not see how to extend this to frequencies. Why should we regard 50-50 as a more *natural* ratio than 51-49? Furthermore, agreeing that it is more natural does not help us with one of the most salient cases of chance, the chance of an atomic nucleus decaying radioactively. For in such a case we need to talk of its chance of decaying *within a certain period*. Thus we can always allow a 50-50 frequency by choosing the time interval appropriately—the time interval that is the half-life for this particular kind of nucleus. And so for simplicity not to be arbitrary we need both natural frequencies and natural time intervals. This is beginning to look most implausible.

4.3.2 *The regularity view of laws and explanation*

Laws have an explanatory capacity. They explain their instances, indeed they explain the regularities we find in nature. Could laws fulfil this explanatory role if they are themselves regularities? Anti-Humeans allege that they cannot.

Facts may explain other facts but they cannot explain themselves. This will be a central assumption of the following argument. Its gist is this. I have a gemstone and find that it is very hard. I look for an explanation of its hardness. The simplest explanation available is that this stone is a diamond and that it is a law that diamonds are hard. There are of course other more sophisticated, deeper explanations that will appeal to the underlying structure of diamond. But these explanations too will appeal to laws that link that structure to hardness and also to the fact that this stone instantiates that structure. Let us stick then with the simple explanation. Would it be explanatory to cite the regularity that all diamonds are hard? One instance of this regularity is the fact that this diamond is hard. But by our assumption it cannot explain itself. So does the remainder of the regularity provide the explanatory power? No, since all that the remainder says is that other diamonds are hard. The fact that some other diamond is hard does not explain why this diamond is hard. Armstrong presents an argument of this kind.[75] In this subsection I shall attempt to give it some

[75] Armstrong (1983: 40) says that the complex fact that all Fs are Gs cannot explain the fact that all observed Fs are Gs since the latter fact is part of the former one. All Fs are Gs = all observed Fs are Gs and all unobserved Fs are Gs. By the assumption stated the first conjunct does not explain why all observed Fs are Gs. Nor could the second conjunct. Therefore the conjunction does not. And so the fact that all Fs are Gs does not explain why all observed Fs are Gs. But we do want it to be possible that the law that Fs are Gs explains why all observed Fs are Gs. Hence the law cannot be identical with the regularity. Clearly the notion of observability is otiose to Armstrong's argument. On the one hand the fact that all Fs are Gs is itself something which may be explained by its being a law that Fs are Gs, and on the other hand, Armstrong's argument may be adapted, as I do, to show that a regularity cannot explain any single instance of it (whether observed or not).

precision. (What follows is meant in no way to deny that *citing* regularities is relevant to our *practices* of explanation. For it is clearly relevant, when one asks for an explanation of why this plant's leaves went yellow and dropped off, to be told that all rubber plants do that when overwatered. The truth of that generalization points towards certain explanations (the physiology of *Ficus elastica* and how that relates to excess water) and away from others (a fungus that this individual plant happened to suffer from). The generalization is useful in that it can point to the explanation even when one is ignorant of its details—one might have no idea what it is about the physiology of rubber plants that causes leaves to fall off when overwatered. But pointing to an explanation is not the same as being an explanation. The regularity may stand as a pragmatic proxy for the real explanation, but only the latter really does the explaining.)

The argument I employ rests on the notion of the ontological content of a fact or set of facts (a notion related to that of ontological commitment). If we allow that there are complex facts that have simpler or more basic facts as constituents then the latter are included in the ontological content of the former. In the simplest case, a conjunctive fact has the combined ontological content of its conjuncts. For one fact to explain another it must have an appropriate ontological content. The idea I shall be making use of is the following: if the content of the fact A includes the content of B, then if B explains E, then A has sufficient ontological content to explain E. The converse is that if A does not have enough content to explain E then B cannot explain E. Part of the point of talking about ontological content is to avoid the subtle question of whether conjunction with another, irrelevant, fact reduces a fact's explanatory power: if the fact that Vesuvius erupted explains the destruction of Pompeii, does the conjunctive fact that Vesuvius erupted and Krakatoa erupted also explain the destruction of Pompeii? Whether or not the conjunctive fact does explain what is explained by one of its conjuncts, it is clear that the content of the conjunction has sufficient ontological resources for such an explanation.

I have not said enough for it to be clear in every case what the ontological content of a fact is. The case of conjunction looks easy. But we cannot say that the ontological content of a fact P includes the content of every fact entailed by P. For the fact of my knowing that Vesuvius erupted entails that Vesuvius did erupt. But we may not want the ontological content of the former, which is a current state of my mind, to include the latter, which was a past state of a volcano. Nonetheless, the notion is clear enough for application in particular cases. I shall also employ a related idea concerning the content of the explanandum rather than the explanans. If A has the ontological resources to explain E, and the ontological content of F is included in that of E, then A has the resources to explain F; in particular, if A has the ontological resources to explain E & F then A has the resources to explain E.

Now consider the following facts:

(1) $(F\mathbf{a}_1 \& G\mathbf{a}_1)$ & $(F\mathbf{a}_2 \& G\mathbf{a}_2)$ & ...

(2) $\mathbf{a}_1, \mathbf{a}_2, \ldots \mathbf{a}_n, \ldots$ are all the Fs that there are.

(1) and (2) jointly entail the regularity all Fs are Gs. (Note that (2) is equivalent to: (2′): nothing is F other than $\mathbf{a}_1$, $\mathbf{a}_2$, ... $\mathbf{a}_n$, ...) Clearly the entailment does not hold in reverse. (1) tells us that some things are indeed F and G; and furthermore (1) tells us things they are. That it is $\mathbf{a}_1$ and $\mathbf{a}_2$ and so on that are Fs, and, according to (2), the only Fs, are facts not entailed by the regularity. So the conjunction of (1) and (2) amounts to more than the regularity—the conjunction has greater ontological content.

I shall argue that the conjunction (1)&(2) does not have the ontological resources to explain the instances of laws that laws ought to be able to explain. Therefore, since (1)&(2) does not have sufficient ontological content for explanation, then the regularity all Fs are Gs cannot have enough either.

Let it be that we want to explain why $\mathbf{a}_1$ (this gemstone) which is F (a diamond), is also G (hard). Again, it is not entirely clear what the explanandum is. The fact requiring explanation is that G$\mathbf{a}_1$, given or conditional on the fact that F$\mathbf{a}_1$. I propose that there are at most three possibilities that would be acceptable to the regularity theorist:

(i) explanandum: F$\mathbf{a}_1$&G$\mathbf{a}_1$; explanans: all Fs are Gs;
(ii) explanandum: F$\mathbf{a}_1\rightarrow$G$\mathbf{a}_1$; explanans: all Fs are Gs;
(iii) explanandum: G$\mathbf{a}_1$; explanans: all Fs are Gs and F$\mathbf{a}_1$.

In none of the cases can in fact the explanans do the job asked of it. In accordance with the above remarks, I shall show that as regards (i) and (ii) the ontologically weightier (1)&(2) cannot provide an explanation of the explananda, and similarly in the case of (iii), (1)&(2)&F$\mathbf{a}_1$ cannot. Correspondingly the weaker explanantia listed above cannot.

Let us consider (iii) first. This is the form of explanation advocated by Hempel (1965) and is perhaps the most promising suggestion. The explanans, (1)&(2)&F$\mathbf{a}_1$, is equivalent to the conjunction of:

(P) G$\mathbf{a}_1$
(Q) (F$\mathbf{a}_2$&G$\mathbf{a}_2$) & (F$\mathbf{a}_3$&G$\mathbf{a}_3$) & ...
(R) $\mathbf{a}_1$, $\mathbf{a}_2$, ... $\mathbf{a}_n$, ... are all the Fs that there are
(S) F$\mathbf{a}_1$.

(P) is identical to the explanandum and so must be irrelevant to the power of the explanation. We should be able to ignore (P) without losing explanatory power. (Q) consists of facts about $\mathbf{a}_2$, $\mathbf{a}_3$, and so on, which do not bear on $\mathbf{a}_1$; hence we should be able to exclude (Q) without loss. (R), being simply about which Fs there are does not contribute to an explanation of why $\mathbf{a}_1$ is G. Lastly, (S) the fact that $\mathbf{a}_1$ is F might well contribute to the explanation of $\mathbf{a}_1$'s being G, for instance if Fness necessitates Gness. But in the absence of any other fact which has potential explanatory power, $\mathbf{a}_1$'s being F is by itself impotent to explain why $\mathbf{a}_1$ is G. Hence (1)&(2)&F$\mathbf{a}_1$ does not have the resources to explain G$\mathbf{a}_1$. And so neither does the explanans in (iii), since that is entailed by (1)&(2)&F$\mathbf{a}_1$.

Now considering (i) in the light of (iii), we can see that (iii) has an ontologically stronger explanans than (i) and a weaker explanandum. Hence if there is no explanation in (iii) then there is none in (i) either.

In (ii) the explanans, all Fs are Gs, is simply the universal generalization of the explanandum, $F\mathbf{a}_1 \rightarrow G\mathbf{a}_1$. Consider the proposition:

(T) $(F\mathbf{a}_1 \rightarrow G\mathbf{a}_1) \,\&\, (F\mathbf{a}_2 \rightarrow G\mathbf{a}_2) \,\&\, \ldots \,\&$ there is nothing other than $\mathbf{a}_1, \mathbf{a}_2, \ldots$.

This entails that all Fs are Gs. By an argument parallel to the one above, (T) cannot explain why $F\mathbf{a}_1 \vee G\mathbf{a}_1$, and so neither can the weaker proposition that all Fs are Gs.

And so on none of the three views of what the explananda and explanantia are in nomic explanation does the proposed explanans have the power to explain the explanandum.

This objection covers all the forms of the regularity theory, not just the simple regularity theory. The natural way to take sophisticated regularity accounts is as saying the following: (a) every law is identical to some regularity; (b) not every regularity is identical to some law; (c) the regularities that are laws are distinguished from those that are not by some factor X. Clause (a) means that the ontological content of laws is the same as the ontological content of regularities, for the sophisticated regularity theorist. And so the objection carries across. The fact that the sophisticated regularity analysis now includes reference to factor X does not have to be taken as adding any ontological content, and so does not add explanatory power. (Compare 'M is a precious metal': 'precious' does not add anything to the causal powers ascribed to M beyond 'M is a metal'.)

Even if we do think of factor X as adding ontological content to a regularity, so a law does have more content than the corresponding regularity, that will not help. For instance, the deductive integratibility required by Lewis does not serve to provide any more explanatory power to a law than is provided by a regularity. That the regularity is an axiom or consequence of the optimal axiomatic system does nothing to change the fact that it cannot explain its instances.

None of this is to deny that in searching for an explanation of why this F is also a G it may be very useful to be told that all Fs are Gs, since the fact that this is so suggests that it is a law that Fs are Gs and so points in the direction of an explanation. A visitor from Africa who had never seen leaves turn yellow and fall from trees in autumn might ask for an explanation and might be satisfied to be told that this happens every year at that time. This is helpful since it suggests that the explanation has something to do with the seasonal variation in climate or perhaps with some biological clock. The stated regularity rules out other possible explanations, such as an opportunistic disease causing the fall of leaves. Furthermore, mentioning the regularity may usefully serve to correct a false presupposition of the question, that the phenomenon is somehow uncommon or surprising. But to rule out certain explanations or to show that a phenomenon is not unusual is not to provide an explanation.

Before concluding that the regularity theory suffers from not being able to ascribe explanatory power to laws, I should consider the fact that one of the two dispositional essentialist ways of thinking about laws also takes laws to be regularities.

Does the current criticism of categoricalist regularity theories of laws mean that the regularity version of the dispositional essentialist view must be abandoned too? The latter says that laws are regularities that hold in virtue of the dispositional essences of properties. But, as I have emphasized, *no* regularity can explain its instances, even if that regularity is a member of some special subset of regularities. So it seems that we must concede that this view of laws also precludes laws from explaining.

I shall suggest that even if correct this objection is not a worrying one. But it is not obviously correct. For the regularity version of the dispositional essentialist view of laws takes them to be necessary, and so the law ought to be framed thus: $\Box\forall x(Fx\rightarrow Gx)$. Armstrong (1991: 508) says that this will not do since it is satisfied 'by a multitude of suitable necessities holding in each individual instantiation ... of the law ($\Box(Fa\rightarrow Ga)$, $\Box(Fb\rightarrow Gb)$, ...).' But this is not quite right. Those instances satisfy $\forall x\,\Box(Fx\rightarrow Gx)$ but not $\Box\forall x(Fx\rightarrow Gx)$. The former is indeed a regularity but the latter is not. And arguably the modal operator provides the unification and the gap between law and mere regularity that the universal quantifier on its own does not.

Nonetheless, putting that response on one side, I do not think that the dispositional essentialist regularity theory suffers from the criticism that regularities do not explain to the same degree as the categoricalist regularity theory. For the former does provide an account of what *does* do the explaining if it is not laws, whereas the latter does not allow *anything* to explain the instances of laws. The categoricalist view denies that there are potencies or indeed any other kind of modality immanent in the world, so nothing of this sort is available to explain. Nothing explains the nomic regularities—the Humean Supervenience thesis says that they merely supervene on the distribution of categorical properties among particulars (and furthermore nothing explains that distribution). The categoricalist has no resources to provide an alternative to laws as the explanantia of their instances. The instances are just brute unexplained facts, upon which everything else supervenes. Clearly the dispositional essentialist does have the required resources—(the essences of) potencies. The following are perfectly satisfactory explanations: **a** is M because **a** has the property P with dispositional essence $D_{(S,M)}$ and then received the stimulus S; the electrons in the beam were deflected away from the cathode because the electrons are negatively charged and the cathode is negatively charged (and negative charge has the dispositional essence such that negatively charged objects repel one another). Although the explanantia entail the explananda, the latter are clearly not any part of the former. The fact of the electrons being deflected is a distinct fact and not part of the ontological content of the fact of the electrons and the cathode being negatively charged. Thus while the dispositional essentialist regularity theory must concede that its laws do not explain, it does show how something else does explain the laws and their instances. Thus although talk of explaining things with laws is strictly mistaken, that is harmless enough because associated with each law is a potency (or set of potencies) that does (or do) provide all the explanation required.

4.4 What is wrong with categoricalism about laws—nomic necessitation

The falsity of the Humean Supervenience claim and the explanation problem imply that there needs to be a greater distance between laws and the particular instances that they explain. The Dretske–Tooley–Armstrong nomic necessitation view does not suffer from this problem. The fact of two universals being related by N is a second-order fact that adds to all the first-order facts (facts about particulars) and generalizations of those facts. So N(F,G), unlike a regularity, does not supervene on the mosaic of local matters of fact, and has sufficient ontological distinction from them to be able to explain them without that being a case of something explaining itself.

Armstrong calls N 'necessitation', although the necessitation he has in mind is contingent. He wants to call it 'necessitation' because where it holds between some F and G, if some *x* is F, it is thereby *required* or *made* to be G. Armstrong wants to capture the idea that nomic necessitation has *some* kind of modal force—not the 'hard' kind associated with full-on metaphysical necessity, but a 'soft' kind associated with nomic modality (including explanatory force and the ability to support counterfactuals) and consistent with metaphysical contingency (Armstrong 1997: 223). It is this soft, nomic necessity that distinguishes laws from regularities and hence the view expressed in LAWS_R. If something is negatively charged it *must* repel another negative charge. It is not merely that it just happens so to do. Armstrong's picture is that it is laws that confer modal features on properties, rather than those properties having them essentially. Thus if a ball that is made of rubber is elastic, that is because the laws of nature impose upon the properties involved in being rubber the disposition to deform non-permanently when subjected to moderate forces (Armstrong *et al.* 1996: 17).

Nonetheless the relation of necessitation itself holds contingently. Thus properties that are related by N in this world might not be related by N, and so might not be nomically related in some other world (as required by PROPERTIES). The rubber ball, with the very same structure of properties, may not be elastic in some other world, since the laws of that world might impose a different set of relations on those properties.

There is a *prima facie* tension between the idea that all non-trivial characteristics of properties and relations (e.g. being involved in laws together) are contingent and the idea that laws can confer some kind of necessitation that goes beyond mere regularity. While the tension seems to be manifest in Armstrong's talk of 'contingent necessitation', identifying a genuine contradiction (rather than an infelicitous opposition of words) is not straightforward.

While LAWS_N seems to be able to avoid the criticisms levelled at LAWS_R, the view it expresses has been criticized on what might be regarded as contrary grounds, that by removing N from the realm of first-order facts, it renders N and its workings mysterious. Bas van Fraassen (1989: 96) articulates what he calls the 'identification problem' and the 'inference problem'. The claim is the one cannot both identify what N is while at the same time explaining how it can have any consequence for particulars (e.g. by entailing a generalization). Any attempt to solve the one problem must leave the other insoluble. Armstrong's (1993) response is that N is an inferred entity. The

best explanation of observed regularities is that there is a second-order relation between universals and that this is the causal relation that is already familiar to us. N, familiar as the causal relation between token first-order facts, is also found in laws applying to *types* of such facts. That solves the identification problem. If the causal relation holds between fact types, then it must hold also between tokens of such fact types. Van Fraassen's (1993) reply focuses on whether we really are entitled to identify a single relation that holds between instances of F and G and also between the universals F and G themselves. I shall not pursue van Fraassen's complaint directly, but will rather show that Armstrong cannot give *any* answer to the inference problem that is consistent with his commitment to categorical monism. For him to answer the inference problem he must allow for there to be relations of metaphysical necessitation between distinct entities. But to do that is to permit potencies or potency-like entities. In which case PROPERTIES is false. And furthermore, we may avail ourselves of these potencies or potency-like entities in explaining laws and repudiate the now-redundant N.

4.4.1 *Does necessitation entail regularity?*

Consider the following partial characterization of N from LAWS_{N}:

(I) ⟨N(F,G)⟩ entails ⟨R(F,G)⟩

This gives N a non-trivial modal property. Compare the second-order relation P(χ,ξ) which holds between F and G whenever possession of F raises the chances of G:

(II) ⟨P(F,G)⟩ does not entail ⟨R(F,G)⟩

N has a modal property that P does not. According to PROPERTIES, however, no natural property or relation has a non-trivial modal character. So either PROPERTIES is false, or (I) is false, or N is not a natural relation.

The idea that N is not a natural relation can be discounted immediately. Armstrong's view is that N is a genuine universal, rather than its being the case that 'N' is merely a predicate corresponding to no real ontological item. This has to be in order for laws to be genuine parts of the world that provide explanations of the way things are. The rejection of N as a genuine universal would force a retreat to Humean regularism about laws or similar.

Since PROPERTIES articulates Armstrong's commitment to categoricalism and is my ultimate target, I must examine what can be done to preserve it. That requires admitting the falsity of (I).

To admit the falsity of (I) is to say that there are worlds where N holds between F and G but not all Fs are Gs. This is as we should expect things to be, given PROPERTIES. Compare:

(III) ⟨*x* and *y* are negatively charged⟩ entails ⟨*x* and *y* experience a repulsive force component⟩ (Abbreviated: ⟨Neg(*x*,*y*)⟩ entails ⟨Rep(*x*,*y*)⟩.)

(III) is false, according to PROPERTIES. In the actual world the property mentioned on the left-hand side, Neg, always confers that on the right-hand side, Rep. But because universals have no non-trivial modal character there will be other possible worlds where Neg does not confer Rep. In the same way (I) should be false. (I) has exactly

the same form as (III) except that (III) concerns first-order relations among particulars while (I) concerns second-order relations among first-order properties. PROPERTIES however does not distinguish between universals of different order. So what goes for (III) should go for (I) also: in the actual world the relation N always confers the relation R on its relata; however there are other possible worlds where N does not confer R.

This may also be seen as a consequence of Armstrong's combinatorial view of possibility. Simple universals (of the same polyadicity) ought to be modally interchangeable (Armstrong 1997: 45-9). That is, where K and L are both dyadic universals, then if in w_1 K and L exist in a certain set of relations to each other and everything else, then there is a world w_2 where things are as in w_1 except that the roles of K and L are reversed (cf. the discussion of quidditism in Section 4.2.1). Thus there ought to be worlds where N plays the role that P plays in the actual world. In those worlds N does not confer the universal R, since P does not do so in the actual world.

4.4.2 *Does necessitation merely imply regularity?*

The claim (I) is part of LAWS_N. So already we see a contradiction between PROPERTIES and LAWS_N. However, it may be that the entailment claim is one that is readily dropped from the picture without significant loss. The question then is, what should replace (I) in LAWS_N, in explicating the relationship between N and R? There seem to be two candidates:

(I*) ⟨N(F,G)⟩ (merely) implies ⟨R(F,G)⟩

and

(I**) ⟨N(F,G)⟩ (contingently) necessitates ⟨R(F,G)⟩.

In (I*) the idea is that it is merely a regularity that whenever, in the actual world N(F,G) it is also the case that R(F,G). It is *merely* such since there is no more to the relation between N and R than material implication—the extension of R includes the extension of N. In (I**) the necessitation is not, of course, entailment, but is rather the same kind of contingent necessitation as N.

Could (I*) be the required replacement for (I)? No, for the very same reason that Armstrong rejects the regularity view of laws. According to Armstrong a mere regularity cannot be used to explain its instances—this is the argument I have elaborated in detail in Section 4.3.2. The fact that all Fs and Gs cannot be enough to support the claim that **a** is G because it is F. (That there is a *law* that Fs are Gs can be used to support the claim that **a** is G because it is F. Hence laws cannot be mere regularities.)

Similarly, if (I*) were true we could not explain why Fs are always G (viz. (R(F,G)) by reference to the fact that Fness necessitates Gness (viz. N(F,G)). The mere regularity that for any F and G, if N(F,G) then also R(F,G) is not enough to support an explanation of R(F,G) by reference to N(F,G). In which case laws cannot explain regularities. Correspondingly the modal character that Armstrong wants to re-introduce to nomic relations is lost.

So we are left with (I**), that N(F,G) necessitates R(F,G) (for all F,G). We may symbolize this: N′(N,R). N may or may not be identical with N′. Arguably a second-order

universal (N) cannot be identical with a third-order universal (N′). This doesn't much matter, for even if N and N′ are not the same, it is clear that N′ is the third-order analogue of N. N′ is more than extensional inclusion—otherwise N′(N,R) would be the same as (I*) which we have just seen to be false in Section 4.4.2. N′ is also not entailment—otherwise N′(N,R) would be the same as (I) which we rejected in Section 4.4.1. So N′ is something between extensional inclusion and necessitation, something which explains, if N′(N,R), why whenever N(F,G) also R(F,G)—and indeed makes it the case that N(F,G).

N′ is the third-order analogue of N because it was introduced to do precisely the job that N was required to do. F**a** cannot explain why G**a** if it is merely a regularity that Fs are Gs; there needs to be a relation of necessitation between F and G (which nonetheless isn't the same as entailment). Similarly, N(F,G) cannot explain why R(F,G) if it is merely a regularity that whenever N then also R; there needs to be a relation of necessitation between N and R (which also isn't the same as entailment).

For just this reason it is clear that we will need a fourth-order universal N′, and similarly a fifth-order universal and so on. There is a regress of ever higher-order universals of necessitation.

Is the regress vicious? Yes. The mere existence of an infinite hierarchy of such relations is not itself objectionable. Consider the claim that every set has a singleton set with which it is not identical. That immediately leads to an infinite hierarchy of sets, but that is no reason to reject the claim. But the case of the infinite hierarchy of N and its relatives is not like this. In the necessitation hierarchy N^n is supposed to have certain quasi-modal and explanatory properties, but it can have them only if they are conferred upon it by some N^{n+1} that has precisely the same kind of quasi-modal and explanatory properties. If so the source of this modality and explanatory force has not been located. There is nothing in the hierarchy that generates these features. In each case they are passed on from the higher-order N to the lower-order N, but we have no explication of whence they come. Another way to see the difference with the hierarchy of sets is this. Imagine we modified the original claim to say that a set *is* identical with its singleton set. Now that hierarchy collapses into just the *urelemente*. That is clearly not problematic. Now suppose that we do the same for the necessitation hierarchy and assert that a third-order universal may be identical with a second-order universal and so on, and that in particular N=N′ and N′=N′ etc. We wanted to explain how it is that N has the power, if N(F,G), to make its first relatum, F, imply its second relatum, G. Our answer was that N and R are related by N′, which has the power to make its first relatum, N, imply its second relatum, R. If N′=N that explanation is blatantly circular. So in the necessitation case the collapse of the hierarchy leads to a circularity, while in the case of the singleton sets the collapse is innocuous. I claim that the fact that the collapse of the hierarchy yields a blatant circularity shows that the uncollapsed hierarchy is the product of a vicious regress.

4.4.3 *Simple universals and Independence*

The argument above employs an assumption that I shall now address. In rejecting (I) I am assuming that N is a simple universal and that N(F,G) is a simple state of

affairs. The claim that properties are categorical and have no non-trivial modal character holds only for simple universals. Complex universals will have modal relations to their constituent universals—⟨being one kilo in mass⟩ entails ⟨having a proper part that is one pound in mass⟩. Armstrong's doctrine of INDEPENDENCE states that if two states of affairs are wholly different, then there is no entailment from one to the other (Armstrong 1997: 140).[76] Atomic states of affairs are wholly different when not identical. However, complex states of affairs may not be identical yet may not be independent either, for the complex state of affairs may have another state of affairs as a constituent, as a consequence of which there may be entailment relations between them. This also restricts the application of the recombination of constituents of states of affairs mentioned above. We can interchange entities *salva possibilitate* only if they are simple.

So we must now ask whether N is simple. If N is not simple then it may be that R(F,G) is a constituent of the complex state of affairs N(F,G), and the denial of (I) is illegitimate. Armstrong himself states the hope that 'the basic nomic connection respects the principle of Independence' (Armstrong 1997: 235). By 'basic nomic connection' Armstrong means either N or the relation that N supervenes upon. If N does satisfy INDEPENDENCE then N(F,G) entails no other state of affairs, and (I) is false. If N is not simple but supervenes on some simple, basic nomic connection N*, then the argument of the preceding sections may be run with respect to N*.

Let us therefore consider the possibility that neither N nor any more basic nomic connection upon which N supervenes is simple. In that case (I) might turn out to be true, for N(F,G) might be a complex state of affairs of which R(F,G) is a proper part. In which case we may write: N(F,G) = M(F,G)+R(F,G). where M(F,G) is whatever is added to the regularity R(F,G) to give us the law N(F,G). We may ask about M(F,G) whether it itself entails R(F,G). Presumably not. For if it did, then M(F,G)+R(F,G) = M(F,G), and so M(F,G) = N(F,G), in which case we would not have explained what N's constituents are and M would not be what we *add* to R to get N. So it must be that N is a combination of R plus something independent of R. Which is just to say that a law is a regularity plus some additional factor. This now makes Armstrong's view of laws just another version of the regularity view. Correspondingly it suffers from the problems that Armstrong identifies in the regularity view. For example, laws are supposed to explain regularities. But if laws just are regularities, they cannot (since something cannot explain itself). Can N(F,G) explain R(F,G) if N(F,G) = M(F,G)+R(F,G)? The R(F,G) component cannot explain R(F,G), on the given principle that something cannot explain itself. Indeed, for that reason, R(F,G) ought not be even a part of what explains R(F,G). Hence the M(F,G) element alone ought to be able to explain R(F,G). But it cannot, since M is entirely independent of R. Similarly, Armstrong argues that the regularity view of laws cannot explain how laws support counterfactuals. The fact that all Fs are Gs (i.e. R(F,G)) does not explain why it is that if **a** were F, then **a** would be G. Can M(F,G) explain such a fact? Consider **b** which actually is F. M(F,G) does not entail

[76] This is a restatement of Hume's Dictum that there are no necessary connections between distinct existences. See below Section 8.1.1.1 for a brief discussion.

that **b** is G—if it did, then M(F,G) would have the same consequence for all the other Fs and so would entail R(F,G) after all. But if M(F,G) does not have the consequence that an actual F is G, how does it have the consequence that some possible F would be G, were it F?

My argument in Sections 4.4.1–4.4.2 assumes that N, or the basic nomic connection upon which N supervenes, obeys INDEPENDENCE (i.e. is simple). Armstrong himself needs this assumption, because without it he would have to regard N as a complex of R plus some other component not entailing R. But this opens his view to the same criticisms that he launches against the regularity theory of laws.

4.4.4 *Nomic necessitation contradicts categoricalism*

Armstrong requires an intimate relationship between laws and regularities. He assumes that it is entailment. But then he has difficulty in explaining how this entailment arises. It cannot be in virtue of full identity between law and regularity, for this is the regularity view of laws that he rejects. Laws are more than regularities. But they cannot be complexes of regularities plus something else, for such a position also suffers from the objections to the regularity view. So laws must be simple yet entail a distinct fact, the regularity. But that conflicts with Armstrong's INDEPENDENCE and the related view that all simple properties are categorical. So the intimate relationship between laws and regularities is not entailment. It cannot itself be a mere regularity, for that relationship is not intimate enough and leaves the ability of laws to explain regularities unaccounted for. So the last option is that laws necessitate regularities where 'necessitation' is just the same kind of modal relation that holds between universals in a law. This option leads to a vicious regress.

That Armstrong's view generates such problems is not surprising. In his view there is no real modality in the basic components of the world. Yet he wants laws to have some kind of modal character, such as the ability to support counterfactuals. Lewis's response is to invoke other, non-actual, worlds as the source of modality. But Armstrong rejects any but the actual world. If modality comes neither from the actual world nor from (relations to) other worlds, then there seems nowhere for it to come from at all. Armstrong's official position is correspondingly a version of fictionalism (Armstrong 1997: 49-51). But he does not extend this to the kind of modality involved in laws and counterfactuals. (I'll return to this in Sections 5.3–5.4.) Can Armstrong divorce the two kinds of modality, one 'hard' kind that deals with metaphysical necessity and possibility and which requires a fictionalist treatment, and another, 'soft' kind found in laws and counterfactuals, which is real and is symbolized by 'N'? Armstrong himself does not divorce them, because he takes instances of soft modality to have entailment properties (laws entail regularities). And entailment is a hard modality. But if he drops the entailment property and employs anything less than hard modality he is unable to explain how we are entitled to infer regularities from laws. After all, there would then be worlds with just the same laws (relations of soft necessitation) but which do not have corresponding regularities. This, it seems to me, is the nub of van Fraassen's inference problem. The argument of this section is

that it is not just that Armstrong has provided no satisfactory answer to the problem but rather that there *can be no* consistent response to the problem.

The argument thus applies not only to Armstrong's view specifically but also to the similar views of Dretske and Tooley. All take the modal character of laws seriously, which motivates their rejecting the regularity view. They nonetheless take nomic necessitation to be soft, a contingent relation, because of which they cannot answer the inference problem. The inference problem is solved only if necessitation has an essence (essentially, if N(F,G) then R(F,G)). But if we allow N to have an essence by which it is related to a distinct property, R, then there can be no objection to allowing F to have an essence whereby it is related to the distinct property G. In which case we may dispense with N altogether. Put most generally the conclusion is this. If we take the modality associated with laws seriously, and we are not willing to employ non-actual possible worlds, then an intermediate 'soft' modality is not an option. The existence of a 'hard', metaphysical modality in the world must be accepted. And the most natural way of so doing is to take laws to be necessary truths reflecting the essences of their constituents.[77]

4.5 Conclusion

The purpose of this chapter has been to articulate the categoricalist conception of properties and laws and then to expose the faults in that conception. The categoricalist conception of properties takes them to be quiddities. Properties do not differ from one another with regard to their essence, except that they have primitive identity. Quidditism raises problems of the swapping of powers and the duplication of properties. I do not regard these as mortal problems for categoricalism. But I do think that they expose the unintuitive aspects of a conception of properties that until recently has gone unchallenged.

The weakness of categoricalism becomes most apparent when we turn to the laws of nature. There is no single categoricalist account of the laws, but two rival theories have dominated, the regularity view, in Lewis's 'systematic' version, and the nomic necessitation view of Armstrong, Dretske, and Tooley. The former suffers from the inability of regularities to explain their instances and from the implausibility of Humean Supervenience. The latter overcomes these problems, but at the price of introducing a relation of nomic necessitation. That relation has been thought by many to be mysterious—or rather, its relationship to instances of a law has been held to be a mystery (the inference problem). I hope to have shown that no attempt to solve the mystery can succeed on Armstrong's own terms. Nomic necessitation cannot do what it is supposed to do without violating the requirements of categoricalism, that a property has no external modal features.

[77] Martin Tweedale (1984) also argues that the logic of Armstrong's position pushes him in the direction of laws with 'hard' necessity and properties with non-trivial essences. Toby Handfield (2005) takes considerations similar to those above to show that the (alleged) modal problems that Armstrong raises for dispositional essentialism would also affect his own view, while pointing out that Humeanism is an alternative way out, which is a view I endorse elsewhere, on slightly different grounds.

If one takes quidditism to be problematic, then that infects the conception of *any* property as categorical. That supports dispositional monism against categorical monism and against the mixed view. The criticisms of the categoricalist views of laws, however, are against views that take *all* properties to be categorical. So those arguments favour the mixed view or dispositional monism against categorical monism. In the following chapters we will look at criticisms of dispositional essentialism and its account of laws.

5

DISPOSITIONAL ESSENTIALISM, MODALITY, AND INTENTIONALITY

So far I have described the difference between the categoricalist and dispositional essentialist conceptions of laws and properties and I have raised objections to the former conception. It is time now to consider objections to the latter, which is the purpose of this and the following three chapters. Responding to these objections will also allow me to articulate dispositional essentialism, dispositional monism especially, in further detail. One objection is that the dispositional essentialist view of laws makes them necessary—a consequence which I defend in Chapter 8. An objection to dispositional monism points to certain properties that seem to resist dispositionalist treatment—structural, including spatial and temporal properties; I consider these in Chapter 7. The third kind of objection, the subject of this chapter and the next, focuses on the very nature of potencies, the fact that they have essences relating them to other properties.

This third kind of objection comes in various related forms. One form is couched in modal terms. The instantiation of a potency involves a relation to another property (the manifestation property), which itself may not be instantiated. Thus it looks as if the nature of one state of affairs involves a relation to another merely possible state of affairs. This raises the concern that the latter cannot be enough to support or fill out the reality of the former. At the same time, it might be said that one ought not to allow any part of the reality of an actual thing to depend on some non-actual thing. A second form of this objection notes that if all properties are potencies, then the manifestation property is itself a potency, which therefore has its own manifestation property and so on. A regress ensues—or vicious circularity. This form of the objection is sufficiently important that I consider it separately in the next chapter. The third form of the objection notes the affinity between a disposition's relationship to its manifestation and the relationship between a mental state and its subject matter. Both are a sort of 'pointing to' which involves a second state of affairs which may be entirely non-actual. If one thinks that intentionality cannot be fundamental but ought to be reduced or explained away, then the same ought to be true of dispositions. Intriguingly some defenders of potencies have embraced this analogy as favouring their view. I shall conclude that none of these objections hurts dispositional essentialism, but at the same time the analogy with intentionality fails to provide any support for the view.

5.1 Potency and its being

Ontology has a number of terms to describe perhaps different kinds or degrees of 'being'. One can say of something that it is, that it exists, that it is real, and that it is

actual. While some philosophers have treated the various pairs of these as equivalent, others have treated the same pairs as distinct. In what follows I will take 'X is', 'X exists', and 'X is real' to be equivalent, and to be true precisely when $\exists y(y{=}X)$. (The quantifier '$\exists y$' may be taken to be appropriate to entities of X's order. So '$\exists y$' quantifies over properties when X is supposed to be a property.) I shall use the term 'being' in the following way. The being of X consists of those facts that are entailed by the fact that X is, in virtue of the essence of X. In effect this is the reverse of Locke's definition of essence as the being of any thing, whereby it is what it is (Locke 1690/1964: 270). The clause 'in virtue of the essence of X' is required because all necessary facts will be entailed by any fact, but not all necessary facts are parts of every entity's being. Thus part of the being of the fact that John loves Mary is that fact that John exists (but not the fact that 2+2=4). The nature of actuality will be addressed later on.

Part of the being of a potency is the existence of a potentiality. Since potencies are essentially dispositional, every potency will have potential manifestations. But these manifestations may be merely potential. A disposition can have unrealized manifestations. So the fact that the fragile glass *would* break if struck is part of the being of the fact that the glass is fragile, even if the glass is never struck and never breaks. We can go further and say that the stimulus-dependent potentiality of a potency exhausts its being. These is no more to the essence of a potency than its potentiality. The combination of a potency's stimulus and manifestation are sufficient to identify a potency (i.e. we reject (QB1)—see Section 4.2.3). The inertial mass m just is the disposition to accelerate at rate F/m in response to impressed force F. There is no potency other than inertial mass with just that manifestation and stimulus.

The fact that the being of a potency is its potentiality is the basis for a pair of criticisms that in effect argue that to regard the being of anything as something that may be merely possible is to locate that being in the wrong place—the being of something actual should itself be actual.[78] This critique has two parts, which I call *too much potentiality* (TMP) and *too little actuality* (TLA). 'Too much potentiality' says that only the actual is real. An unmanifested potentiality involves a possibility that is non-actual. So something whose being includes potentiality cannot be properly real. 'Too little actuality' says that because a potency's potentiality exhausts its being, and because potentiality can be *mere* potentiality, the being of a potency has nothing to guarantee its reality.

I shall argue that potencies are no worse off in these respects than categorical properties which can be related in laws by a relation of nomic necessitation. These considerations lead us to rather more general reflections concerning modality and the being of merely possible entities.

5.2 Too little actuality

The TLA expresses the common view that potencies (powers) do not have enough reality on their own to be all there is to the properties of things in the world. In Howard

[78] I shall illustrate these arguments with quotations from David Armstrong, and while those quotations are suggestive, I do not wish to impute these argument to Armstrong himself.

Robinson's words, that view regards 'a world of powers as too insubstantial to command belief' (1982: 114); he describes it as an 'etiolated conception of matter'. Stated thus, the TLA would yield the conclusion that no property could be a potency. But the TLA is more usually presented as implying that not *all* properties could be potencies. Thus Armstrong writes:

> Can it be that everything is potency, and act is the mere shifting around of potencies? I would hesitate to say that this involves an actual contradiction. But it does seem to be a very counter-intuitive view. The late Professor A. Boyce Gibson, of Melbourne University, wittily said that the linguistic philosophers were always packing their bags for a journey that they never took. Given a purely Dispositionalist account of properties, particulars would seem to be always re-packing their bags as they change their properties, yet never taking a journey from potency to act. For 'act', on this view, is no more than a different potency. (1997: 80)

This suggests the criticism of dispositional monism that if everything is just potency, there isn't enough actual being in the system. Keith Campbell's (1976: 93) criticism of Boscovich's theory in *A Theory of Natural Philosophy* likewise proceeds thus, 'Is it possible for anything to be constituted by nothing but causal powers? Whatever the answer is to that question, I doubt very much whether it is possible for *everything* to be constituted by nothing but causal powers. But that seems to be the situation in Boscovich's system. When one point moves another, all that has been shifted is a power to shift powers to shift . . . But powers to shift *what*?'[79] Here is how Ellis (2002: 171) characterizes an objection from Richard Swinburne, 'If all of the properties and relations that are supposed to be real are causal powers, then their effects can only be characterized by their causal powers, and so on. So causal powers are never manifested. They just produce other causal powers in endless sequence.' John Foster's (1982: 68) version is similar, '. . . there seem to be no physical items in terms of whose behaviour the content of the powers could be specified, and consequently, it seems that, in the last analysis, there is nothing which the powers are powers to do.'

Stated thus, the TLA is a version of the regress or circularity argument I address in the next chapter. Consider the analogy with the circularity of definitions. One way of understanding that problem is that we think of a definition giving meaning to a definiendum because the definiens already has meaning. Definition is a way, as it were, of *passing on* meaning, not of creating it *ab initio*. A system where all meanings were given by definitions would not have any semantic value in the system to be passed around by those definitions. What is needed is some other way of providing meaning, e.g. an ostensive definition linking a word to a thing, so that the system as a whole has some real meaning (semantic value) that can be passed on to the definienda. Similarly one might think that a dispositional statement can only represent some real state of affairs because its stimulus and manifestation conditions are

[79] Campbell goes on to suggest that the dilemma could be escaped if we introduce an 'intrinsic quality' that is not some further power. That is, he proposes the mixed view, with some categorical properties, as the solution. This is also Ellis's view (2002: 171).

at least possible real states of affairs. But if the stimulus and manifestation conditions are themselves mere potencies, there seems to be insufficient reality in the system as a whole. What is needed is that at least some properties are non-dispositional in order to inject some genuine being into the system. As Armstrong goes on to say, 'Perhaps accepting that the purely spatiotemporal properties are categorical will give enough categorical basis to blunt the force of this criticism.'

The TLA is often expressed using the words of G. K. Chesterton, 'We cannot all live by taking in each other's washing' ('especially in the form of pinafores . . . ' the quotation continues).[80] Thus conceived there are two parallel responses to the objection. First, it simply assumes what it sets out to show, that potencies do not have sufficient reality to be genuine properties without the support of something else. This is particularly clear in the quotation from Ellis characterizing Swinburne's view, which assumes that if the effect of some power (potency) is the instantiation of some other power, then that is no manifestation. This betrays the assumption that potencies do not on their own have enough reality to constitute a genuine manifestation? The second response is to urge that when we compare properties understood as the dispositional essentialists do with properties understood as categorical properties, we see that there is no reason to regard the former as any less real than the latter.

Hugh Mellor (1974: 157) once described an anti-dipositionalist prejudice thus, 'Dispositions are as shameful in many eyes as pregnant spinsters used to be—ideally to be explained away, or entitled by a shotgun wedding to take the name of some decently real categorical property.' It is this prejudice that is behind the objection under discussion. Thus one might think that dispositions can be admitted only insofar as they are reducible to some counterfactual. That counterfactual will mention certain antecedent and consequent states of affairs. But if dispositional monism is correct, then the properties involved in those states of affairs are themselves essentially dispositional and will need to be reduced to counterfactuals if they are to be admitted. It seems as if we are faced either with regress or with circularity.

The clear and simple response for the potency theorist is to deny that dispositions are respectable only if they are reducible to counterfactuals (or something else). The dispositional monist's thesis is that real properties just *are* dispositions, and are necessarily those dispositions. Thus she will reject immediately the assumption of the objection that dispositions are real only if they are really something else. Once we reject that assumption, the objection falls apart. Even if it were true that dispositional statements are equivalent to counterfactual or subjunctive conditionals (which, strictly, they are not), we need not infer that dispositional properties inherit their reality or acceptability from those conditionals. Essentially dispositional properties may form a network, but it is not the function of the network to spread around a component of being.

The dispositional essentialist may bolster this response by asking why it should ever be thought that essentially dispositional properties have less being than categorical properties. What is there to a categorical property? To repeat Black's characteri-

[80] Cf. Russell (1927: 325) and Blackburn (1990: 64).

zation of Lewis's Humean fundamental qualities, which are categorical properties by another name, 'Just about all there is to a Humean fundamental quality is its identity with itself and its distinctness from other qualities. A Humean fundamental quality is intrinsically inert and self-contained.' To be precise, we may list the essential features that can be attributed to a categorical property thus:

(a) it is distinct from (i.e. not identical with) other properties;
(b) it is a universal and thus can have instances;
(c) for some n it is an n-adic universal.[81]

Now consider what the essential features of a property are, as understood by the dispositional essentialist. As presented above, potencies are universals, satisfying (b). If the potency is 3-adic because it has a two-part stimulus, then it will be essentially 3-adic, on the grounds that the stimulus and manifestation of a potency are essential to it, satisfying (c). If one accepts the necessity of identity, then one believes that it is a necessary truth concerning *any* entity that it is distinct from other entities. I think that a potency theorist can (and again should) accept the necessity of identity, satisfying (a). Hence necessary distinctness from other properties will be a feature of potencies as well as categorical properties.[82] Thus everything attributable to the being of a categorical property is also attributable to the being of a potency. What distinguishes potencies is the *additional* claim that they have (essentially) a dispositional character. Thus there is *more* to the being of an essentially dispositional property than there is to that of a categorical property. In which case the claim that essentially dispositional properties are lacking in reality unless reducible to or explicable in terms of a 'decently real categorical property' is in error. If anything the boot is on the other foot. The thinness of the nature of a categorical property should raise questions about *its* sufficiency for reality.

(The last *ad hominem* response from the dispositional essentialist claimed that the essential features attributed to the being of a categorical property are a proper subset of those attributed to a potency (and hence the latter cannot have any less being than the former). The categoricalist might respond that there is something that categorical properties are supposed to have that potencies do not have, viz. primitive transworld identity—they are quiddities: the dispositional essentialists' claim is precisely that potencies do not have primitive transworld identity (since transworld identity is secured by identity of dispositional character). This remark does little to undermine the force of the *ad hominem* response. The possession or lack of primitive transworld identity conditions or any other kind of transworld identity conditions is not relevant to the reality of some entity in the actual world—it is relevant only to the question, which is the same entity in some other world. Thus this difference between essentially dispositional and categorical properties is not enough to give a reality to

[81] Because he rejects uninstantiated universals, Armstrong would add: (d) it has at least one instance. That issue has no direct bearing on the current one—the potency theorist *could* accept that (d) is true of potencies (although I do not). See Section 3.2.2 for a discussion of Armstrong on uninstantiated universals.

[82] Whether such distinctness is also part of the *essences* of potencies and of categorical properties is perhaps debatable (cf. Fine 1994). But presumably, as regards this point, what goes for categorical properties will go for potencies and vice versa.

the latter that it withholds from the former. After all, Lewis does not regard primitive transworld identity as necessary for the reality of particulars. Strictly his particulars have no transworld identity whatsoever. And his substitute for transworld identity, counterparts, is a qualitative theory of (pseudo-)transworld identity.)

5.3 Too much potentiality

The TLA argument accused potencies of having too little actual being to be genuinely real at all. This accusation failed to show what *would* be sufficient for actual being. And certainly categorical properties have less total being than potencies and the same or less actual being than potencies. By contrast, the TMP argument accuses potencies of having *more* being than they should. Given the response to the TLA argument, the TMP might seem on firmer ground. It can accept that whatever being categorical properties have, potencies have as well. But, so the argument goes, the extra being possessed by the potencies is somehow illegitimate.

There are two respects in which Armstrong regards the (extra) being of potencies as illegitimate. The first respect is what he regards as the intentionality of potencies. The second respect is the non-existence of the extra being, in the case of unmanifested dispositions.

A disposition, says Armstrong, points to its manifestation, and in the case of an unmanifested disposition, it points to something that is non-existent. We may illustrate the case with the property of fragility. If fragility were a potency, it would essentially be the property whose manifestation is breaking in response to the stimulus of being suitably stressed. This is the case even if the fragile object is not stressed and does not break. Armstrong's 'pointing to' is a metaphor. It is not that the analysis of 'fragile' involves the concept 'breaking', since we are doing metaphysics, not conceptual analysis. Rather it must be an ontological pointing to. (The illustration is only an illustration, not an example, because the potency theorist is entitled to decline to regard fragility as the sort of natural, physically basic sort of property with which he or she is concerned. If an example is required, spin, a property of subatomic particles may meet the case. Spin is the property of a particle, which under the 'stimulus' of motion through a non-uniform magnetic field, manifests itself as a force transverse to the direction of travel.)

Armstrong has two problems with this pointing to a breaking that did not occur. The first respect in which this pointing to is illegitimate, is that it is a 'pointing to' at all. However the metaphor is spelt out, the basic things in the world should not have this kind of feature, viz. *intentionality*. I shall examine this complaint later in this chapter. The second complaint is that the pointing can be a pointing to *what is not actual*. Insofar as what is pointed to is part of the being of the potency, the being of a potency may involve a non-actual state of affairs. So although the being of potencies may have something extra that the being of categorical properties does not have, the charge is that this extra being is illegitimate, in virtue of involving states of affairs that (it is agreed on all sides) are sometimes non-actual, being merely potential. For there seems something wrong with the being of the actual involving the non-actual. Here is how Armstrong puts the point, '…how can a state of affairs of a particular's

having a property enfold within itself a relation (of any sort) to a further first-order state of affairs, the manifestation, which very often does not exist? We have here a Meinongian metaphysics, in which actual things are in some way related to non-existent things' (Armstrong 1997: 79; cf. Armstrong *et al.* 1996: 16-17).

I will consider three responses to TMP. The first points out that one cannot in fact deduce the possibility of the manifestation from the potency alone. The second argues that there really is no TMP problem, since what is doing the work are relations among universals, not between first-order states of affairs. The third argues that unrealized possibilities should be accepted as parts of the actual world in any case. The second and third responses are backed up by an *ad hominem* argument which shows that Armstrong's view is equally susceptible to a TMP argument.

5.3.1 *No possibility in, no possibility out*

Is the potency view really committed to unrealized possibilities after all? One reason for thinking not, is that one cannot deduce the possibility of a manifestation from the fact of the instantiation of a potency. Let us imagine that fragility were a potency, and that it is instantiated in some particular vase. One cannot deduce the possibility of the vase's breaking from the fact of its being fragile alone, even if a subjunctive relation between stressing and breaking is part of the essence of fragility. What one needs is the additional premise that stressing of the vase is possible. One might conclude therefore that, in Armstrong's terms, the fragile vase does not on its own point its own non-actual breaking; rather it is the combination of the vase's being fragile and its being possible that the vase is stressed that points to the possible breaking of the vase. If that's right, then it is a mistake to allege that the potency theory implies that there is some mysterious involvement of the merely possible (a non-actual breaking) in what ought to robustly actual (the vase's being fragile). For the merely possible breaking is a product of actual fragility *and* the merely possible stressing. But there is nothing mysterious about the merely possible being involved in a combination of the actual and the merely possible. We only get mere possibility out because we implicitly put mere possibility in.[83]

As a response to Armstrong this may not convince. Even if there is no possibility out without possibility in, potencies seem nevertheless to be able to multiply possibilities. The possibility in was the possible stressing of the vase. But we get out quite a different possible state of affairs, the possible breaking of the vase. So it still seems that there is something involved in the potency that goes beyond the merely actual—otherwise one would expect the possibility one gets out not to go beyond that which one put in.[84]

[83] A further consideration is, of course, that we need to also specify the (com)possible absence of finks and antidotes in order to deduce the possibility of the manifestation.

[84] We may also consider cases where the possibility of S**a** is itself necessary, or, more generally, cases where necessarily, if $D_{(S,M)}$**a** is actual, S**a** is possible. For example, it is necessary that if some vase is fragile it is (metaphysically) possible that it is struck. In such cases, the existence of $D_{(S,M)}$**a** can be said to entail the possibility of M**a**, in virtue of its essence. I shall take this to be given in what follows.

5.3.2 *The* tu quoque *TMP argument—unrealized possibilities in categoricalism*

In response to the version of the Too Little Actuality argument considered above, the potency theorist was able to respond that the categoricalist position (e.g. Armstrong's) is at least as vulnerable to the same argument, were it sound. Again, in the case of Too Much Potentiality, the potency theorist's response is "*tu quoque*". Let $D_{(S,M)}$ be the potency that is the property whose essence is to manifest M in response to stimulus S. Armstrong's objection is that some object (call it '**a**') may possess $D_{(S,M)}$, yet because **a** never receives S it never manifests M. So M**a** is a non-actual possibility, which, we shall take it, is a part of the being of $D_{(S,M)}$.

Let us see how the same objection would apply to Armstrong's own position. Armstrong rejects the existence of any potency such as $D_{(S,M)}$. In its place he posits a universal D* and a law relating D* to the universals involved in the stimulus and manifestation (call them S* and M*). The law we may symbolize by N(D*&S*,M*), to show that the universals D* and S* contingently 'necessitate' the universal M*. Let **a** be some object. According to Armstrong the law N(D*&S*,M*) and the possession by **a** of the categorical property D* are the joint truthmaker for the statements '**a** is disposed to manifest M* in response to S*' and 'were **a** to be S* it would be M*'. And this is the case even if **a** never is S* and so never is M*. Now since a truthmaker entails the truth of the proposition it is a truthmaker for, the existence of the combination of D***a** and N(D*&S*,M*) entails the truth of 'were **a** to be S* it would be M*' and so of 'it is possible that M***a**'. If 'it is possible that M***a**' is true, then it is possible that M***a**. Consequently, the existence of the combination of D***a** and N(D*&S*,M*) entails the possibility that M***a**, a possibility that in this case is non-actual.[85] And so a non-actual possibility is part of the being, not of D***a** alone but of the being of the combination of D***a** and N(D*&S*,M*) together.

Thus even on Armstrong's account of dispositions and their related counterfactuals it is the case that the being of an actual state of affairs or a combination of states of affairs, in this case D***a** and N(D*&S*,M*), involves some unrealized, non-actual possibility. If the fact that the being of an alleged X would include a non-actual possibility is a reason to doubt the existence of Xs, it is a reason to doubt the combination of laws and categorical properties on Armstrong's conception.

5.3.3 *The type-level response*

Thus it looks as if the TMP argument is just as effective against a categoricalist view, such as Armstrong's. How might Armstrong respond to the objection?

Armstrong's account of the possession of a dispositional property by some object is this. The object possesses a categorical property or complex of such properties. Being categorical these do not involve a relation to something else, and *a fortiori* do not involve a relation to a non-actual something else. However, the categorical property is not itself enough to account for the dispositional character of the disposition in question. What gives it its contingently dispositional character is a law of nature that

[85] If this is denied on the grounds that the possibility of D***a** is required to make the entailment go through, then that is just to employ the 'no possibility in, no possibility out' response of Section 5.3.1. In which case the latter must be permitted as an adequate response to the criticism of potencies.

relates this categorical property and a stimulus property to a manifestation property. That is, Armstrong would say, the truthmaker for 'the vase is fragile' should include both (a) the vase and its categorical microstructural property-complex C, *and* (b) a law of nature (which is a second-order relation among first-order universals) relating the property C and the stimulus property, striking, to the manifestation property, breaking).

Now the invocation of a law of nature *does* involve a relation to something else, for the law is itself a relation between universals, and in addition to the universal C, the law will involve the universals involved in stressing and breaking. However, for the property realist, these universals are genuine, actual entities. So although there is a relation here to something else, the something else is an actual thing. So the diagnosis of the problem is this. The TMP argument focuses on the token-level, the level of particulars, and takes the disposition to involve a relation to a non-actual particular or token state of affairs (a broken vase, the breaking of the vase). But the explanation of all of this can be done at the type-level, and at that level all that is require is a relation to something fully actual, the manifestation universal.

If that is a satisfactory response to the TMP argument as deployed against Armstrong, then there is an equally satisfactory response to it as deployed against the potency theorist. The quick way to see why this must be so, is to note that the difference between the two—Armstrong's categoricalist view and the potency theorist's view—can be expressed simply as a difference over whether properties and laws are potentially separable or not. Where I see a potency, Armstrong sees a categorical property and a law. The difference is thus a modal one, whether one could have the same property but a different dispositional character (because of a different law); Armstrong says yes, I say no. It doesn't seem as if this difference is a difference in relation to particulars or token states of affairs. And so if a type-level response to the TMP is available to Armstrong, it should be available to me.

The essence of a potency does involve a relation to something else. If inertial mass is a potency then its essence involves a relation to a stimulus property (impressed force) and a manifestation property (acceleration). This replaces Armstrong's contingent relation that is a law connecting these universals. In both cases the relation in question is among universals. Thus as regards the nature of the potency itself, there is no need to invoke a relation to anything objectionable. Now let us turn our attention to the instantiation of a potency by a particular. The nature of this fact is fully explained by explaining the nature of the potency (which I have just done), explaining the nature of the particular (no different from Armstrong's case), and that the latter instantiates the former (again no different from Armstrong's case). As in Armstrong's case this entails that there is a possibilium that is the manifestation of the potency. But also, as in Armstrong's case once more, we do not need to invoke any relationship to that possibility in order to explain either the nature of the potency or the nature of the fact of its being instantiated by a particular.[86]

[86] Cf. Mumford (2004: 194) for this kind of response to the problem of unmanifested possibilities.

Thus it simply is not true that explaining the nature of an unmanifested potency (the fragile but well-cared-for vase) requires invoking a relation to its non-existent manifestation. In this respect potencies and intentionality (to which I shall come later) clearly differ. If I am thinking of Napoleon, the nature of that case of intentionality cannot (so it seems) be explained in terms of the *type* to which Napoleon belongs.[87] Consequently, it looks as if Yoshiko's problematic relationship to Sherlock Holmes ought equally not be explained in terms of the type to which Holmes belongs. By contrast, the explanation of the nature of a potency (and any instantiation thereof) is explained by reference to the type of the manifestation. If this magnet is disposed to attract a piece of iron in its neighbourhood, that disposition is to be explained by reference to the type (being iron) of any candidate for manifestation.

5.4 Armstrong, modal realism, and actualism

So was the TMP an entirely misguided objection to both the potency view and Armstrong's after all? No, I do not think so. That objection was that the *being* of a state of affairs involving an unmanifested potency involves some further, non-actual state of affairs. However, the type-level response just canvassed argues that the dispositional character of a property (whether thought of as a potency or as a categorical property) can be *explained* without invoking that non-actual state of affairs. But that's an answer to a slightly different question. The answers to 'what explains **a**'s having character C?' and 'what is the being of the fact of **a**'s having character C?' may overlap but will typically not be identical. In particular the answer to the latter will involve everything that is entailed by the fact of **a**'s having character C, which may be more than is mentioned in an explanation of **a**'s having character C. (Likewise the explanation of X may involve things not part of the being of X.)

So TMP as an argument about an allegedly objectionable component of the being of a potency remains in force. The only defence mounted so far is to show that Armstrong's own view is liable to the same criticism. Is there more to be learned from this exchange? Or are both views mistaken, with a third view being required? My proposal is that because such different views both suffer from the same apparent criticism, that criticism must itself be in error. In this section I shall try to diagnose this error, and to draw out some of the more general consequences for modal metaphysics. However, I should point out that while I believe that what follows is the right way forward for modal metaphysics, I do not think that the view is required for a defence of dispositional essentialism against its critics. For if the *tu quoque* response is correct, the problem in question is one which must be faced equally by Armstrong or indeed anyone who is not a modal realist. If one thinks that one has some better modal metaphysics for Armstrong's view (such as the fictionalism Armstrong once gave some support to), then that modal metaphysics is equally available to the dispositional essentialist.

The *tu quoque* argument suggests that any view will have this consequence:

[87] Those who follow Quine's programme for the elimination of singular terms will disagree.

> (A) the being of something purely actual (something that is a part of the actual world) can include some unrealized possibility;

if that view accepts either of the following:

> (B1) non-trivial counterfactuals can be made true by facts in the actual world alone; or
> (B2) unmanifested dispositions can be parts of the actual world.

For the being of an unmanifested disposition and the being of a counterfactual state of affairs involve unrealized possibilities. And if the unmanifested disposition is fully part of the actual world or the counterfactual is true in virtue of the way the actual world is, then unrealized possibilities must be part of the actual world. The only way of avoiding (A) is by denying (B1) and (B2). Thus the Megarian actualist denies that a disposition can exist without being manifested, i.e. they deny (B2). For example, according to Aristotle, this kind of actualist denies that a thing can act except when it is acting, and so denies, for example, that a builder has the power to build if he is not actually building (cf. Prior 1985: 12-14). If the actualist gives counterfactuals a standard possible-world semantics, then counterfactual propositions collapse into the corresponding material conditional. Thus they become trivial—the proposition that Mr Weedy would lift the one-tonne car if he tried to is true so long as he does not in fact try. This requires a denial of (B1) also, because non-trivial counterfactuals are denied. Modal realists, such as David Lewis, also deny (A) and so also deny (B1) and (B2). But in their case they do not reject unmanifested dispositions and unrealized possibilities. So what they reject in (B1) and (B2) is not the existence of these things, but rather that their existence depends solely on the actual world. Their existence depends also on the way things are in other equally real possible worlds.

For this reason the *tu quoque* response to the TMP argument is not simply an *ad hominem* of limited interest. Rather it shows that what was held to be a feature (an objectionable feature) of the potency theorist's view is in fact an unavoidable feature of *any* view that accepts the existence of unrealized possibilities without modal realism. After all, if other possible worlds are not real, the non-actual possibilities, since they exist, must exist in the actual world. That does leave the question, how can the non-actual be part of the actual, without contradiction? But that question is a question that must be answered by anyone who is neither a Megarian actualist nor a modal realist (i.e. by most metaphysicians). I shall sketch an answer in the next section.

In rejecting (A) above, the modal realist and the Megarian actualist share a commitment to:

> (MR-MA) If some unrealized possibility exists, it exists (at least in part) in some other possible world.

(If A is false, then the being of something purely actual cannot include an unrealized possibility, and in particular the actual world cannot include an unrealized possibility. Hence if some unrealized possibility exists, it exists (at least in part) at some other possible world.)

Where the modal realist and Megarian actualist part company is in their attitude towards the truth or falsity of the antecedent and the consequent of (MR-MA). The modal realist accepts the antecedent and so accepts the consequent. The Megarian actualist denies the consequent and so denies the antecedent also.

Armstrong's TMP argument shows that, officially, he rejects (A). In which case he needs to decide whether he is a modal realist or a Megarian actualist. Clearly he is not a modal realist. So is he a Megarian actualist? It appears that his sympathies are very close to actualism. The argument of this section, to this point, is that if he rejects (A) and rejects modal realism, then he ought to accept Megarian actualism. This is problematic for Armstrong, because he does not want to share the Megarian actualist's rejection of our talk of unmanifested dispositions and other unrealized possibilities. Indeed rather than reject all unrealized possibilities, he has a theory about which unrealized possibilities there are. The possibilities that there are, are combinations of elements of the actual world (Armstrong 1989*a*). The key question is then, are these combinations real? Clearly not, with the exception of the one combination that is the actual world. So how do these unreal combinations have any bearing on the truth of modal statements? Armstrong's initial answer was that they are fictions. There are two ways of taking fictionalism. The first takes possibility statements themselves to be fictions. This would parallel Field's fictionalism about mathematics. On this view statements asserting unrealized possibilities are false, but they nonetheless may be useful in certain ways. Such a view would be a version of Megarian actualism. An alternative would be to take 'possibly *p*' to be true iff according to the fiction of possible worlds there is a world where *p*. The latter view denies (MR-MA) and so accepts (A). Thus unrealized possibilities are parts of the actual world. But in an unproblematic way, analogous to the unproblematic way in which the works of Conan Doyle are parts of the actual world. The latter view faces various problems that have been discussed by Gideon Rosen and which have led Armstrong to give up his fictionalism. Now he proposes worlds as mereological sums of atomic entities (particulars, universals). There is not space here to discuss this idea in detail, let alone the objections it faces. It is nonetheless worth noting two points relevant to the current discussion. First, if mereological sums really do exist without that committing us to modal realism, then they are parts of the actual world. So (A) is true after all on this view. In which case Armstrong cannot rely on the intuitive implausibility of (A) in his TMP argument. Put conversely, Armstrong objects that unmanifested dispositions point to unrealized possibilities, and so seem to take us beyond the actual world. But why should we accept that conclusion? Why is it not that they point to a mereological sum, or to something else that is fully part of the actual world?

Secondly, Armstrong's account of possibility requires his INDEPENDENCE as an axiom—simple entities are (modally) independent of one another (see Section 4.4.3). This principle itself entails that no simple property is a potency; and since no complex of categorical properties can constitute a potency, it entails that no property is a potency. If Armstrong's use of the TMP argument is an appeal to pre-theoretical intuitions about modality, that is fine. But if we try to make the arguments more robust, by thinking hard about the detailed nature of modality, we find that Armstrong's an-

swer rules out potencies right from the beginning. In which case Armstrong cannot use his answer as the basis of an argument against potencies without begging the question.

5.5 There are unrealized possibilities

In Section 5.3 I considered the accusation that the potency theorist imbues the world with unmanifested possibilities. My response was that Armstrong must imbue the world with the same possibilities. Indeed, I argued that anyone must imbue the world with these possibilities unless they are either a Megarian actualist or a modal realist. There is thus a very general problem for anyone, such as Armstrong and myself, who rejects both Megarianism and modal realism. In this section I sketch an answer to this problem. While I do not suggest that it is the only possible answer to this problem, I do think it is the most plausible solution.

Consider the blank piece of paper in front of me. I could turn the piece of paper into an origami swan. But I never will—instead I'll use it to light a fire and then burn it. The fact that I could make it into an origami swan means that it is possible that there is an origami swan. The modal realist accepts these claims, but regards them, in effect, as non-modal claims not about the actual world but about other possible worlds. The Megarian actualist will deny the relevant claims. There is no possible origami swan created from my piece of paper, whether in this world or any other. The argument of Section 5.4 is that if we reject both of those we have no option but to regard the possibility of the origami swan as a part of this world.[88] But what are possibilities? In this case it seems pretty clear that the possibility is the possible origami swan itself. That is, for there to be the possibility of an origami swan is for there to be a possible origami swan. And so there are unrealized possibilities. Another way of seeing this is to reflect on the fact that we can count unrealized possibilities just as we count realized ones. I throw a die and the outcome is '3'. Just as there are six faces there were six possible outcomes to the throw, one of which was actual and five of which were merely possible. The fact that we can talk of six (undeniably existent) faces and six possible outcomes in the same breath suggests that the quantification involved in the former is the same as the quantification in the latter and that in both cases the quantifier has maximal scope.

If effect I am suggesting that in rejecting (MR-MA) and accepting (A) we should commit ourselves to the Barcan formula:

(BF) $\Diamond \exists x \mathrm{F}x \rightarrow \exists x \Diamond \mathrm{F}x$

The merits and demerits of the Barcan formula have been much discussed and we cannot consider them here in detail. The grounds for accepting BF go beyond the naturalness of talking of 'six possible outcomes'. Any account of modality that accepts possible worlds (however conceived), makes BF plausible, since the antecedent

[88] That there are possibilities to be quantified over is most obvious for the truthmaker theorist, since he or she requires the existence (and not just the possible existence) of something to make '$\Diamond \exists x \mathrm{F}x$' true. That of course does not tell us what possibilities are. That said, the following does not depend on the truthmaker idea and indeed seems to be inconsistent with it.

will be understood as 'there exists a possible world w and there exists some x such that x is F at w'. Thanks to the commutation of existential quantifiers that implies 'there exists some x and there exists a possible world w such that x is F at w' which is just the consequent of BF. More significant is that fact that BF is a theorem of the most natural systems of quantified modal logic, e.g. S5 plus the normal quantifier rules with identity.[89] It is true that Kripke's semantics for modal logic provides for relatively straightforward models in which BF is false. But it should be noted that the axiomatization of modal logic then becomes much more complicated. Furthermore, the Kripke semantics is not without its own problems, since it demands of the object language that quantification is restricted to particular domains, corresponding to possible worlds, whereas the metalanguage is not so restricted. In the metalanguage we are able to say that there are things in other worlds that are not in the actual world, (indeed we must be able to say this in order to assert that BF is false). That assertion quantifies over entities in all the domains, not just the domain of the actual world (see Williamson 1998). As Christopher Menzel (2005) puts it, 'That BF ... [is] unprovable in Kripke's system, it seems, is metaphysically irrelevant. For it appears that, nonetheless, the semantics itself is wholly committed to possibilism.'

It seems to me that the intuitive rejection of the Barcan formula has its source in the same picture that drives the inclination to think that if there is any modality at all, there must be non-actual possible worlds.[90] What picture should replace the one I reject? It is not clear that having any picture is helpful in modal metaphysics. To this extent I am inclined to think that Wittgenstein was right when he instructed us to do away with pictures and instead look carefully at the grammar—if by the latter we understand a careful attention to logic. Part of the problem arises from the way Armstrong and others talk of unrealized possibilities. By talking of 'non-actual' possibilities it is tempting to think that either there really are no such things (Megarian actualism) or that there are such things but only at other, non-actual worlds (modal realism). It would beg fewer questions (and accord better with ordinary usage) to talk of 'unrealized' possibilities rather than 'non-actual' possibilities.

If we take 'unrealized' to mean 'non-actual' then the insistence on unrealized possibilities is to deny actualism. But we can understand realization in a way that is consistent with actualism but denies Megarian actualism. The simple actualist says that everything that exists is actual; the Megarian actualist adds that unrealized pos-

[89] Cf. LPC=S5 in (Hughes and Cresswell 1996: 243-4, 312-13) and S5QT= in (Girle 2000: 55-6). Note that although BF is not a theorem of the system K plus classical first-order logic, BF is validated by the simplest models of such a system, and is consequently standardly added as an axiom (Linsky and Zalta 1994). BF is also a theorem of B plus classical first-order logic.

[90] I suspect also that this picture is supported by the truthmaker principle, accepted by Armstrong, that every truth is made true by some thing. It is noteworthy that Timothy Williamson (1999) argues that the truthmaker principle is inconsistent with the converse Barcan formula ($\exists x \Diamond \mathrm{F}x \rightarrow \Diamond \exists x \mathrm{F}x$) (CBF). David Efird has pointed out that that the entities quantified over on the right hand side of BF look just like the sort of thing that would be the truthmakers for statements of possibility, including statements concerning unrealized manifestations. To accommodate the truthmaker principle we would have to reject not only CBF but also the symmetry principle: $p \rightarrow \Box \Diamond p$. To me this seems too high a price to pay. In any case I note that Armstrong wants his truthmaker principle to do philosophical work, whereas truthmakers generated by BF will be had too easily. Armstrong would demand *concrete* truthmakers.

sibilities are non-actual (i.e. (MR-MA)). As argued above, we may reject (MR-MA) by insisting that unrealized possibilities are actual. On this view BF is consistent with actualism and anxiety about its allegedly counterintuitive (non-actualist) character may be assuaged. According to this view all possible objects are actual objects. The principal distinction is between realized possibilities and unrealized possibilities; the main difference between these is, roughly speaking, that only the former have non-modalized properties. That is, someone who does make an origami swan has created something with the property of looking like a swan, but the possible origami swan that I could have made but didn't, does not have this property. Rather it is such that it possibly looks like a swan. The former origami swan makes it the case that $\exists x \mathrm{S}x$ (where Sx iff x looks like a swan), whereas my possible origami swan suffices only for $\exists x \Diamond \mathrm{S}x$. In the light of this there is no reason to suppose that the being of potencies extends beyond 'the actual world' (viz. the domain of quantification) into some other possible world. There is but one world and it contains all of the being of potencies.

What are unrealized possibilia? The best way to understand them is as akin to Platonic abstract objects—except that they are contingently abstract. They could be realized and so could be concrete. That is the distinction between the realized and unrealized is not the distinction between the actual and the (merely) possible, but between the concrete and (contingently) abstract (see Linsky and Zalta 1994 and Williamson 1998).

The kind of actualism just described requires that all possible particulars exist (as does possibilism). It is worth noting the parallel to the Platonic conception of universals I explored in Section 3.2 according to which all possible universals exist. Corresponding to the realized/unrealized (or concrete/abstract) distinction for particulars is the instantiated/uninstantiated distinction for universals. That parallel does invite therefore the same naturalistic response to unrealized possibilities (non-concrete particulars) that Armstrong (1997: 41) raises for uninstantiated universals, particularly in the form of the Eleatic Principle, 'Everything that exists makes a difference to the causal powers of something.' But as he says (1997: 149), 'The merely possible can stand in no causal relation to the actual. Only the actual can have effects upon the actual. Indeed, the merely possible cannot stand in any *external* relation to the actual, for instance in any spatio-temporal relation.'

The Eleatic Principle, as Armstrong states it, takes the form of a supervenience claim. It rules out there being two worlds such that in the first x exists but in the second x does not exist, yet the causal powers of everything in the two worlds are the same. Understood thus, the principle has no problems with possibilia. CBF rules out pairs of worlds where a possibilium exists in one but not in the other for the reason that what is possible exists at all worlds. As noted in Section 3.2.2, if universals are necessary, then they cannot be excluded by a difference-making principle such as the Eleatic Principle; the same goes for particulars. More generally, necessary beings, whatever their nature, cannot be excluded by supervenience principles.[91]

[91] Necessary existence, $\forall x \Box \exists y(y=x)$, is a consequence of the systems of quantified modal logic considered above. It is also a consequence of CBF plus Serious Actualism, the thesis that nothing may have a property without existing. But note that the Eleatic Principle permits unrealized possibilia even without

One might think that the Eleatic principle ought to be formulated in stronger terms: *everything that exists is causally active*. Such an approach does, however, rule out all sorts of other abstracta, sets and numbers in particular. The cost of denying these is notably high. Nor is their rejection required by naturalism. As I have mentioned, if one's naturalistic principles are formulated in terms of supervenience, then necessary entities are left untouched. Quine's naturalism admits sets on the grounds of their indispensability to science, and one can argue that modal properties and relations, in the form of either potencies or laws, are also indispensable to science. Secondly, it rules out objects that are causally isolated. That seems unmotivated. So one might want to accept entities that could be causally active. But then that admits unrealized possible manifestations, since that very same entity could be causally active also—that unrealized manifestation would be causally active if realized in the right circumstances.

Lastly, it is unclear that even the requirement that only the causally active exists rules out (mere or abstract) possibilia. After all, it is the possibility of the vase's breaking that causes me to treat it with care. Here is another case. Let an object that is not fragile be made fragile by cooling. Let it then be heated again so that it is no longer fragile. During the period of fragility there is an unmanifested disintegration of the object. That unmanifested disintegration, which was not present initially, was brought into being by the cooling of the object. So that cooling caused the existence of the unmanifested disintegration. Hence an unrealized possibility can enter into causal relations, by being an effect of some unarguably real event or fact. Now consider a case where a fragile object is struck and does disintegrate. That disintegration will have various effects (surprise, a noise, a mess, a cut finger). The disintegration is the same event as the possibility of disintegration changing from being unrealized to being realized. So it seems correct to say that the possibility of disintegration, by becoming realized, had various effects. The point is most clear on a counterfactual analysis of causation. Had the possibility of breaking not existed (i.e. had breaking been impossible), there would have been no surprise, noise, mess, etc. In this case, then, an unrealized possibility can enter into causal relations by being a cause.

5.6 Dispositional essentialism and intentionality

Consider two features of potencies. First, in Armstrong's (1997) language, potencies 'point to' things beyond themselves, their manifestations. Secondly, the power to

taking possible manifestations to be necessary beings. We may consider possible manifestations to exist only at worlds where the relevant potency and manifestation universals exist. Let x be the possible state of affairs which is the possible (but unrealized) manifestation of a potency D in an object **a**. As we have discussed, the existence of the state of affairs D**a** entails the existence of x. Now consider a world in which x does not exist. Since the existence of D**a** entails existence of x, a world in which x does not exist is a world in which D**a** does not exist. Hence in the world without x the object **a** cannot possess the potency D. And so the existence of the unrealized possibility, x, does make a difference to the causal powers of something, viz. **a**. So even if it is true that unrealized possibilities do not themselves cause anything, it remains the case that their existence can make a difference to the causal powers of things. Put another way, the Eleatic Principle is satisfied by anything that supervenes on the causal powers of things. And that is true of unrealized manifestations of the causal powers of things.

bring about such manifestations (in appropriate circumstances) is immanent; it is held entirely within the potency, rather than being thrust upon the potency by something distinct and external (a contingent law of nature). Several authors have seen close connections between these features and properties of the mind. In the first place, the feature of pointing to an external manifestation looks to be parallel to the intentionality of the mind, the ability to think *about* something—including, typically, something outside itself. Secondly, the immanence of powers in potencies is akin to the view we have of ourselves, as thinking, acting creatures that are able to do things at our own instigation, to choose what happens to us and to things around us. This is part of what Wilfrid Sellars (1962, 1997) calls the 'manifest image', and it contrasts with the view of all things in the world not as self-moving but as pushed and pulled around by external forces generated by the laws of nature (the 'scientific image'). Thus in these two respects, potencies at first sight seem 'mind-like'.

The mind-likeness of potencies has been used both as a criticism of them and in support of them. On the one hand Armstrong (1997) argues that an important task for philosophy is to show how the intentional can be explained in terms of the non-intentional. But such a task would be pointless and the mystery of intentionality unsolved if everything is after all intentional. On the other hand, U. T. Place (1996) is happy to accept the intentionality of potencies, while Brian Ellis (2002) thinks that the immanence of powers in potencies is a way of reconciling the scientific and the manifest images, by making the true scientific image much more like the manifest one.

5.6.1 *Do potencies explain intentionality?*

Let us use 'intentionality*' to refer to the character of potencies whereby they 'point' to their manifestations. Place (1996) holds that that intentionality* = intentionality and thus that potencies have intentionality. He recasts Brentano's (1874) famous dictum that intentionality is the mark of the mental by holding that intentionality is the mark of the dispositional. If this were the case, could it solve or dissolve the problem of intentionality? Could it be that the mind has intentionality because even the physical properties upon which it supervenes have intentionality?[92]

In this section I argue that this could not be true, because we have no reason to suppose that intentionality is the sort of quality that depends for its possession by X on the possession of the same kind of quality by the parts of X. I note, parenthetically, that even if this argument is mistaken, and that the intentionality of the mind is somehow inherited from the alleged intentionality of physical properties, the lack of any explanation as to how this dependence operates means that this proposal does next to nothing to provide an explanation of mental intentionality. Consequently, such a relation provides no confirmation to the hypothesis that there exists physical intentionality. That is, merely *asserting* that physical intentionality (intentionality*) would explain mental intentionality doesn't give us much reason to believe in phys-

[92] John Heil (2004: 442-3) seems to propose something like this in suggesting that Molnar's powers might explain representational intentionality, '…representation might be thought to stem from more fundamental dispositionalities present in intelligent creatures.'

ical intentionality—we need some plausible description of *how* it explains mental intentionality. Neither Place nor Ellis has provided this. In any case, as I intend to show, not merely is there no reason to think that physical intentionality would explain mental intentionality, there is every reason to suppose that it could not.

5.6.2 *Compositional properties*

Let us call a property P of an entity X *compositional* if the possession of P by X depends on the possession of P (or a parallel determinate of the same determinable) by the parts of X.[93] 'Depends' here is vague and can be made more precise for particular purposes. For the present examples will suffice. In classical physics mass is compositional in a simple additive way: the mass of an object is equal to the sum of the masses of its parts (or, strictly, equal to the sum of the masses of all the members of a complete set of non-overlapping parts of the object). The velocity of any body is the velocity of its centre of mass and that depends not only on the velocities of the parts but also on their masses and relative positions. So in general velocity is compositional in a slightly more complex fashion.

Some properties are not compositional. The horsepower of a motor-car engine is not dependent on the horsepower of any of its parts. Emergent properties are not compositional.[94] But a non-compositional property need not be emergent. It may be possible to deduce the power of an engine from its design. Let D<**a**,**b**> be the direction of the line joining the centres of objects **a** and **b**, then D is not a compositional property of the ordered pair <**a**,**b**>, although it is not emergent either.

In some cases compositionality is relative to the set of parts under consideration. Colour is a tricky case because the colour of a large visible area is dependent on the colour of its smaller visible parts. A large square is red if and only if all its four quadrants are red. On the other hand, if we consider its molecules as the relevant parts, then it is false that the colour of the whole depends on the colour of parts, although the colour of the whole may depend on other properties of the molecules. Shape is similar. The square is a square iff its four quadrants are square. On the other hand the shape of the square object does not depend on the shape of its molecular parts. They could be more or less any shape (or none at all) but still form a square if arranged in the right way relative to one another. Such properties I will call *semi-compositional*. A property P of object X is semi-compositional iff:

(i) for some set S of (non-overlapping) proper parts of X, P is compositional relative to S;
(ii) for some set S* of (non-overlapping) proper parts of X,
  (a) P is not compositional relative to S*
  (b) the possession of P by X supervenes on facts about S*
  (c) there is no set S** of (non-overlapping) proper parts of X

[93] Compositionality is thus not a characteristic of properties *simpliciter* but rather of their instantiation in a given particular. An alternative would be to regard compositionality as a characteristic of tropes.

[94] Or, strictly, the lowest level of emergent properties are non-compositional; properties that depend compositionally on emergent properties might count as emergent under some definitions. These are what I call semi-compositional properties (see infra).

> that are themselves parts of the members of S* such that P is compositional relative to S**.

The idea in (ii) is that at some level the compositionality breaks down. While P may be compositional relative to big parts it isn't compositional relative to small parts. Condition (c) asserts that there is a lower bound on the level at which compositionality still holds. One might expect (c) to be a consequence of (a) and (b). I will reserve the term *acompositional* for properties that are neither compositional nor semi-compositional. A property is non-compositional if it is not compositional (and so is either semi-compositional or acompositional).

5.6.3 *Intentionality is non-compositional*

Intentionality is non-compositional. It is either semi-compositional or acompositional. We might regard it as semi-compositional for some cases, for example in cases where we think that the mind is modular. The intentionality of the whole will depend in some way on the intentionality of the modules. But this, on its own, is not held to be any sort of explanation of the intentionality of the mind in general. It is clear that the intentionality of the mind or of its modules is not built up out of the intentionality of the smaller physical parts of its physical realizer. And certainly no attempt to explain or reduce intentionality suggests that it is. (Similar remarks may be made with respect to a representational theory of mind.)

So, for example, let it be that S is thinking about Napoleon. Clearly this is not a consequence of S's neurons individually having intentionality directed towards Napoleon; nor is it a consequence of their having intentionality directed towards anything else. This is true whatever account of intentionality one holds. First, one might have a causal account of intentionality—my thought is about Napoleon because he caused it. Having a thought or any kind of mental state is itself non-compositional and the causal relation that is supposed to explain this thought's intentionality would be between Napoleon and at least some structure of neurons, not between Napoleon (or anything else) and individual neurons. Secondly, one might have a representational account of intentionality—my thought is about Napoleon because it contains some representation that picks out Napoleon, such as a mental image of Napoleon. Again the property of being an image of something, mental or otherwise is a non-compositional one. One might hold that a portrait of Napoleon is a portrait of that man because it uniquely resembles him. But it is the picture as a whole that uniquely resembles Napoleon. So although the bit of the painting that represents his ear may resemble his ear, it may also resemble many other ears, and this may be true of all the smaller parts of the painting, yet it may be that the whole painting resembles only Napoleon. If unique resemblance were the explanation of intentionality then the whole painting would be of Napoleon without that being *because* its parts are paintings of the parts of Napoleon (the relationship would be the other way around—the painting of the ear would be of Napoleon's ear because it is part of a painting of Napoleon). Even more clearly, we do not expect the whole to be of Napoleon in virtue of the individual brushstrokes or the molecules of oil paint being *of* anything. Lastly, one might explain intentionality in evolutionary terms. The mind or its mod-

ules represent in virtue of their having evolved in response to certain kinds of selection pressure. Again, the relevant items that have evolved are large-scale structures, not their smallest parts, and consequently such an account makes intentionality also non-compositional.

I do not intend to endorse any particular account of intentionality. But what is clear is that any standard way of understanding intentionality will render it non-compositional. This argument is not exhaustive—perhaps the intentionality of the mind is after all compositional, depending on the intentionality of its smallest parts in some subtle way not yet considered. But there is no evidence that this is so. I conclude that there is every reason to to regard intentionality as non-compositional, and no reason to suppose that it is. Since intentionality is non-compositional, the fact that all properties have intentionality* is irrelevant. Even if it exists, the intentionality (proper) of charge, spin, and mass would do nothing to explain the intentionality of minds.

5.7 Are potencies intentional?

The nature of a potency is no more than its being a property whose essence is to be disposed to bring about a certain manifestation in response to a certain stimulus. That is all there is to a particular potency. Armstrong then goes on to articulate the following objection:

> Consider, then, the critical case where the disposition is not manifested. *The object still has within itself, essentially, a reference to the manifestation that did not occur.* It points to a thing that does not exist. This must remind us of the *intentionality* of mental states and processes, the characteristic that Brentano held was the distinguishing mark of the mental, that is, their being directed upon objects or states of affairs that need not exist. This intentionality of the mental undoubtedly exists. But for physicalists such as myself it presents a *prima facie* problem. If the mental has intentionality, and if, as Brentano thought, it is also *ontologically irreducible*, then there is something here that would appear to falsify Physicalism. Physicalists about the mind are therefore found trying to give some ontologically reductive account of the intentionality of the mental. But if irreducible dispositions and powers are admitted for *physical* things, then intentionality, irreducible intentionality, has turned up in everything there is.
>
> Is this not objectionable? Does it not assimilate the physical to the mental rather than the other way around? (1997: 79; original emphasis)

We have already seen that dispositional essentialism does not assimilate the physical to the mental in a way that allows an explanation of the relevant features of the mental. However, even if as argued the intentionality of the mental is not reducible to the intentionality* of the dispositional, it does not follow that intentionality* is distinct from intentionality; nor does it follow that intentionality* is less in need of reduction or explanation than intentionality.

The task of this section is to show that the characteristics widely regarded as marks of intentionality do not all apply to intentionality*. If that is correct, then the metaphysics of potencies does not imply, *pace* Armstrong, that 'intentionality . . . has

turned up in everything there is.' Nor, *pace* Place, is 'intentionality the mark of the dispositional.'

5.7.1 *The marks of intentionality*

Martin and Pfeifer (1986) have argued that the traditional marks of intentionality, as identified by Lycan (1969) and by Searle (1979), do indeed fail to distinguish intentionality as a characteristic of the mental and not of the physical (i.e. those marks do not distinguish intentionality and intentionality*). But they hold that there *is* a distinction and therefore that the characterization of intentionality needs improvement. Place, however, regards their argument as showing that intentionality and intentionality* are identical. Stephen Mumford (1999) on the other hand argues against Place that there is a distinction and uses this to motivate a better conception of intentionality* (what he calls 'physical intentionality'). I shall show that the divergences between intentionality and intentionality* are greater than all concerned have supposed, and that no special adjustments to our conception of mental intentionality and physical intentionality* are required in order to see that they are clearly different.

Let us begin by listing the marks of intentionality. By 'mark' I mean a necessary (but not necessarily sufficient) condition. If X***R***Y is intentional then:

(i) There is a *directedness* from X to Y. The property picked out by the predicate '…***R***Y' is *about* Y or *of* Y. Thus if I am thinking about Napoleon, my thought is about Napoleon, it is directed towards that man (cf. Searle 1983: 1).

(ii) The context 'X***R***…' is an intensional context. The principal indicator of intensional contexts is that substitutivity fails for them. Let S have the form: '…*D*…' and S′ be S with '*D*' replaced by '*D*′'. According to Zalta, substitutivity asserts that from S and '*D* is identical to *D*′' we may validly infer S′.[95] A more common and slightly different version states that the transition from S to S′ is truth-preserving when *D*=*D*′. When '*D*' is a referring expression, the failure of substitutivity is referential opacity.

(iii) Possible inexistence of Y or of T where 'T' is a singular term within 'Y' (cf. Brentano 1874: 88-9, Chisholm 1957: 170). So Yoshiko, mistakenly believing that Sherlock Holmes exists, can nonetheless admire Sherlock Holmes and his methods. (Note that on some views (ii) and (iii) are both consequences of a common set of characteristics of intentionality. Let intentionality be fine-grained—distinct senses lead to distinct intentional states. Let senses be conceived of descriptively, so that distinct senses may pick out the same entity and senses may pick out none at all. Then one would expect intentionality to yield both opacity and possible inexistence.)

A related mark is identified by Chisholm (1957), viz. that the truth of X***R***Y where Y is propositional implies neither the truth nor the falsity of Y. This is a corollary of

[95] Zalta (1988: 1-6) regards as intensional any sentence that for which one of the four following principles fail: (i) Substitutivity; (ii) *Existential* generalization. Let S have the form: '…*D*…'. From S we may validly infer: 'some existing thing is such that … it …'. (iii) Existential generalization. Let S be as above. From S we may validly infer: 'something is such that … it …'. (Existential generalization plus the claim that everything there is exists, gives *Existential* generalization.) (iii) Strong extensionality. Let S be of the form 'Necessarily, all and only Fs are Gs' and S′ be of the form 'Being an F is the same thing as being a G' (where 'F' and 'G' are predicative expressions). From S we may validly infer S′.

possible inexistence, in that if Y contains a non-referring singular term, then Y will not be true. (This is not the same as not being truth-functional.)

Note, however, that this pair of related 'marks' are not strictly marks in the sense given, since they are not after all necessary. For intentional success verbs (e.g. knows) do create contexts where the embedded proposition must be true and relevant singular terms must refer.

(iv) Indeterminacy of Y. I can think about Napoleon at the moment the first shot was fired at Waterloo, without thinking of him as having some particular number of hairs on his head at that moment, even though there is some such number. Thus, in a sense, the Napoleon of my thought is indeterminate while the real Napoleon is not (cf. Anscombe 1965).

(v) The property picked out by '…***R***Y' is an extrinsic property. I may be thinking of Napoleon but my swamp-man molecular twin is not. The semantic value of Oscar's water-thoughts differ from the semantic value of Twin-Oscar's twater-thoughts even though those persons are internally identical. Their thoughts are directed onto different kinds. Since the two subjects are intrinsically alike but their thoughts have different intentions, it follows that in such cases the intentional character of thought is an extrinsic property of the subject. (Externalists argue that the external/extrinsic nature of thought is irreducible, that is, it is not the product of an internal/intrinsic property of thought plus environmental conditions, that is, it is not the case that broad content is to be explained as narrow content plus additional factors.)

(vi) Where 'X***R***Y' holds in virtue of a causal relation, the direction of causation is from Y to X. The features of thought referred to in (v) are often explained by taking ***R*** to be a species of causal relation between the thought and its object. While this is inadequate as a full account of intentionality, it is plausible as part of what is involved in intentionality in many cases. In such cases the direction of the causal relation is from the object to the thought. If my thinking of Napoleon is a matter of a causal relation between Napoleon and me, then the relation is one whereby Napoleon causes my thought, not the other way around.

5.7.2 *Does intentionality* have the marks of intentionality?*

Armed with this list of the marks of intentionality we may now consider whether intentionality* possesses these marks and so whether there is a case for identifying intentionality* and intentionality.

(i′) *Directedness* Most commentators from Brentano onwards—including, as regards the issue of the intentionality of potencies, Armstrong, Place, and Molnar—see this as the fundamental feature of intentionality. Place makes it clear that he thinks that (i) is a sufficient condition of intentionality. If so, and it were agreed that intentionality* shows directedness, then intentionality*=intentionality. Such a case is however very weak. In the first place, we have a list of further conditions that are also necessary but which are not entailed by this one. Furthermore, the notions of 'directedness', 'pointing to', etc., are ill-defined. As Mumford (1999) points out, a falling rock can be directed towards the road below. Or any vector quantity can be regarded as pointing. But those facts do not impel us to regard falling rocks or magnetic fields

as having intentionality. So something more must be meant by 'directed' and 'pointing'. Agency clearly shows directedness: one acts or strives to bring something about, but one wouldn't want to ascribe agency or striving to dispositions. As Mumford remarks, the fragile object doesn't aim to become broken. Furthermore it couldn't, since agency of this sort requires being able to attribute the agent with a concept of what is being striven for, with a plan for attaining the object striven for, and so forth. (Nonetheless, Ellis, we shall see, does want to attribute agency to entities possessing potencies.)

Place doesn't want to attribute agency to potencies—he has a feedback account of what is involved in agency. So the conception of directedness that he attributes to potencies must be less than that involved in agency but more than that involved in merely having a direction. Although he does not say so, the intentionality of mental states exhibits intentionality without agency. My thought is about Napoleon without that thought in any way striving towards Napoleon or even *my* striving towards Napoleon. Arguably the directedness of thoughts and the directedness of potencies has one important parallel. For one may argue, especially if one is a thoroughgoing externalist, that the object of a thought is essential to it. My thought about Napoleon could not be *that* thought if it were about someone else. Similarly, according to the potency view, it is essential to an object's possessing a certain inertial mass that it display a corresponding resistance to acceleration by an imposed force. But it is not essential to that fact of the rock's falling that it is falling towards that road. In another possible world the same rock is falling in the same way towards a stream or towards an unspoilt mountainside.

(ii′) *Intensionality* Place deliberately ignores those characteristics that are marks of intensionality (or 'S-intenSionality' as he calls it), since he regards the latter as a feature of locutions and sentences whereas intentionality applies to states and events (Place 1996: 105). But that is not really relevant: it can still be a mark of intentionality that sentences describing intentional states are always intensional (Zalta 1988).[96] Sentences asserting intentional states clearly do not obey substitutivity. Using Zalta's version: from 'Edgar knows that John le Carré writes spy novels' and 'John le Carré is identical to David John Moore Cornwell' we may not validly infer 'Edgar knows that David John Moore Cornwell writes spy novels'. Likewise such contexts fail to preserve truth *salva veritate*. (Nor do they obey *existential* generalization; nor, depending on your point of view, existential generalization.) There is, however, no parallel to intensionality in the case of dispositions (nor, in particular, potencies). The sentence 'the solubility of salt manifests itself as dissolving in warm water' remains true for any co-referring replacement for 'dissolving in warm water' (e.g. 'forming a solution in H_2O between 8°C and 80°C').

Molnar (2003: 64), however, thinks that there is a parallel. He says that the statement:

(A) Andrew believes that George Eliot wrote *Middlemarch*

[96] It has been suggested that there are some exceptions to this, in the case of non-epistemic seeing (Dretske 1969). However, it is debatable whether such instances are intentional at all.

does not entail:

(B) Andrew believes that Mary Ann Evans wrote *Middlemarch*

Similarly, he says:

(A1) Acid has the power to turn this piece of litmus paper red

does not entail:

(B1) Acid has the power to turn this piece of litmus paper the colour of Post Office pillar boxes

This is not a successful way of putting the argument that Molnar intends since the failure of entailment between (A1) and (B1) is matched by a corresponding failure in non-intentional and non-intentional* contexts:

(X) Ripe tomatoes are red

does not entail:

(Y) Ripe tomatoes are the colour of Post Office pillar boxes

—unless one takes 'the colour of Post Office pillar boxes' to be a rigid designator, by being elliptical for 'the actual colour of Post Office pillar boxes'. But in that case not only does (X) entail (Y), (A1) also entails (B1), and so the analogy with (A) and (B) breaks down.

The issue that Molnar intends to draw our attention to is, of course, whether the transitions from (A) to (B), and from (A1) to (B1) (and from (X) to (Y)) are, in fact, truth-preserving—given the identity of the substituends. In the case of (A) and (B) it is not, if Andrew doesn't know about the identity of George Eliot and Mary Ann Evans, whereas between (X) and (Y) the transition is truth-preserving. Molnar denies that the transition from (A1) to (B1) is truth-preserving, on the ground that 'power to turn litmus paper red' denotes a genuine intrinsic power of acid, whereas 'power to turn this piece of litmus paper the colour of Post Office pillar boxes' is a predicate to which no single power property corresponds. We may construe this objection to the truth-preservation claim thus. The statement 'acid has the power to turn this piece of litmus paper the colour of Post Office pillar boxes' would be true only if acid had a power that somehow tracked changes in the colour of pillar boxes—should the Post Office undergo a rebranding involving repainting the pillar boxes ultramarine, then acid would turn the piece of litmus paper ultramarine. Clearly acid does not have such a power, so (B1) is false.

Undoubtedly this is right. But it does not reflect anything like referential opacity. It is sometimes said that operators such as 'it is a law that…' are referentially opaque. The transition between (U) and (V):

(U) Emeralds are green
(V) Emeralds are the colour of the curtains in my office

is truth-preserving, but, allegedly, between (U1) and (V1) it is not:

(U1) It is a law that emeralds are green
(V1) It is a law that emeralds are the colour of the curtains in my office.

It is, however, a mistake to infer from this that 'it is a law that…' is referentially opaque. According to those, such as I, whom Mumford (2004) calls 'nomological realists' about laws, law statements are true in virtue of relations among natural properties. For example, on Armstrong's view (U1) should be symbolized thus:

(U2) N(E,G)

where 'E' and 'G' are not predicates but are expressions referring to (sparse, natural) universals.[97] In which case the interpretation that makes (V1) false should be symbolized:

(V2) N(E,C)

Now note that there are two ways of reading (V1) so as to yield something of the form of (V2). The first reading takes 'the colour of the curtains in my office' to be a description that picks out a certain sparse universal, the colour my curtains *actually* have at this moment. That universal is green, hence 'C' in (V2) has the same reference as 'G' in (V1) and so the transition from (U1) to (V1) is truth-preserving after all.

The second reading of 'the colour of the curtains in my office' takes it to be an expression referring to the sparse universal corresponding to the predicate 'being the same colour as my curtains, whatever that should be'. But clearly there is no such sparse universal, which is why (V1) is false (or perhaps lacking in truth-value). But note that since 'G' and 'C' are referring expressions which do not refer to the same thing ('G' refers to the sparse universal of being green whereas 'C' refers to no universal at all), the transition from (U1) to (V1) is not one involving the substitution of co-referring expressions. The mistake made in thinking that the failure of truth preservation between (U1) and (V1) shows referential opacity arises from taking 'it is a law that …' to be a genuine propositional operator. But if we see that the form of law statements is really that given by (U2), then we see that (U1) does not have (U) as an embedded proposition. In particular, whereas 'green' occurs in (U) as a predicate, in (U1) it occurs as the name of a property.

It should be no surprise that the same can be said as regards (A1) and (B1). When giving the canonical characterization of a potency (which is itself a natural property) in terms of its manifestation, the manifestation is also a natural property. Thus, in general, if we say that the manifestation of D is M, 'M' should be understood not as a predicate but as a term referring to a natural property. And so if we make (B1) false by involving an interpretation whereby the manifestation 'turning the colour of Post Office pillar boxes' is something different from the manifestation 'turning red' then that is because those expressions are being treated as referring expressions whose function is to pick out sparse, natural properties. But in that case they are not co-referring expressions, and so the failure of truth preservation between (A1) and (B1) is not an indication of anything like intensionality.

(iii′) *Possible inexistence* Place and Armstrong see this condition as closely bound up with directedness, although it isn't necessary that directedness implies possible inexistence. According to Armstrong a potency points to its manifestation even when

[97] For sake of argument I shall take colour properties to be sparse universals.

that manifestation fails to come about (e.g. because the potency has not received its stimulus). It is this possible inexistence that Armstrong regards as the most problematic characteristic of intentionality and the reason why we should not allow primitive intentionality, as we would have to if there are potencies and intentionality* is identical with intentionality.

Since this is the crux of Armstrong's criticism of potencies I shall consider it in greater detail below. However, we should first note two reasons why the kind of possible inexistence need not be regarded as a strong indicator of intentionality. First, I mentioned above that both intensionality and potential inexistence may, according to some views, be regarded as having the same source. (For example if sense/content are descriptive, then one would expect both states that are opaque and states that lack reference. Note that Chisholm regards possible inexistence as a mark of intensionality.) If the possible inexistence associated with intentionality* were analogous to or the same as the possible inexistence associated with intentionality, then one would expect intentionality* to display intensionality as does intentionality. However, above I argued that intentionality* does not imply intensionality. Consequently we may conclude that the possible inexistence associated with intentionality* must arise from a quite different source. And so, on the relevant accounts of sense and content, possible inexistence cannot be a reason to regard intentionality* as the same as intentionality. Secondly, and reinforcing the first point, there are non-intentional (and non-intensional) sentential contexts that suffer from very similar problems. Consider the sentence 'Pegasus does not exist'. This is true (rather than truth valueless). But it is not trivially true. Nonetheless, the context is neither intentional nor intensional. Consideration of the logic of such cases has led various authors to adopt the view that there are merely possible objects. And so, as I argued in Section 5.5, if potencies require non-existent potential manifestations, that need have nothing to do with intentionality. We need not infer from the fact (if accepted) that potencies point to their non-existent manifestations that this assimilates the physical to the mental. Rather it may reflect a much more general requirement of logic.

(iv′) *Indeterminacy* Do the manifestations of dispositions show indeterminacy? *Prima facie* it might appear that they do. There are innumerable ways a fragile vase might break in manifesting its fragility. But more careful inspection shows this parallel to be illusory. Given determinism, if the vase is dropped in a particular way or struck in some specific manner, there is only one fully determinate way it will in fact break. We might wish to say that the fragility of the vase points to an infinite number of determinate manifestations, each conditional on a specific implementation of the stimulus. But an infinity of fully determinate objects is not the same as a single indeterminate one.

Molnar argues that potencies can display a physical analogue of the indeterminacy of intentionality when those potencies are *propensities*, that is essentially and irreducibly probabilistic potencies such as are displayed in the indeterministic decay of a radioactive atom. Although a propensity to decay will be directed towards that decay, the moment at which that decay will occur is not determinate. This is merely a weak analogy that does nothing to establish any significant parallel. If it

did, we would expect propensities to reflect the intentional* character of potencies in general. But they do not. For example, one might think that the indeterminacy of intentionality reflects the descriptive character of much thought and in particular the fact that descriptions may be incomplete. Clearly nothing like this explains the indeterminacy of propensities. Molnar seems to take the indeterminacy of propensities to provide an analogy to the *vagueness* of thoughts: I can expected a phone call *soon*: 'The time at which I expect the call is quite appropriately described by that fuzzy indexical expression 'soon', the use of which gestures towards a vague time-span. There *is* no definite time such that I expect the call at that time.' (Molnar 2003: 62-63) But there is nothing vague about the indeterminacy of propensities. The half-life of a radioactive nucleus is perfectly precise, as is the probability of its decaying within a given time interval. Indeterminacy in the case of propensities is indeterminism—there being no prior state that causally necessitates the decay. Indeterminacy in thought is the lack of a complete description. And indeterminacy in the case of vagueness is a matter of there being borderline cases where we cannot say whether the predicate applies or not. The first is quite unlike the second or third.

(v′) *Extrinsicality* Dispositions can be extrinsic, as Jennifer McKitrick (2003) has argued. Nonetheless, her arguments do not show that potencies may be extrinsic and in particular they do not show that fundamental potencies may be extrinsic. On the contrary it seems as if such potencies are intrinsic. For example, Yablo and McKitrick have argued that weight is dispositional but extrinsic, since two identical objects may have different weights (one on the Earth, the other on the Moon). But in this case it is clear that the property that is doing the work is the mass of the objects and that is identical for both. (It is true that in special relativity, mass is extrinsic, but then the explanatory property is rest mass, which is intrinsic.) No-one has suggested that charge, rest mass, and spin are not intrinsic. Thus while the extrinsicness of intentionality is irreducible, extrinsic dispositions are reducible to fundamental potencies that are intrinsic.

(vi′) *Direction of causation* If I think about Napoleon, that thought is caused by Napoleon. However, the causal relation between a potency and its manifestation is the other way around. The potency or disposition (with its stimulus) cause the manifestation, not vice versa. Thus the arrow of intentionality is in the opposite direction to that of causation whereas the arrow of intentionality* is in the same direction as the causal arrow.[98]

This is not to deny that an intentional state X***R***Y can ever cause it to be the case that Y. For clearly it sometimes can—my intention to eat chocolate causes me to be eating chocolate. But this is nothing to do with intending being intentional and everything to do with its also being a disposition of a certain kind, a disposition to make it the case that Y. In this case, and in a few others (such as desiring), the propositional content of the state and its dispositional manifestation coincide. Other intentional states are also dispositions but with manifestations that do not coincide with their

[98] Arguably there may be exceptions in the case of artifacts. Perhaps Stephen Sauvestre and Gustave Eiffel were thinking of the eponymous tower before it came into existence and those thoughts caused it to come into being.

propositional contents, or even explicitly involve not causing those contents to be true (consider fearing that or being completely indifferent whether).

5.7.2.1 *Conclusion—intentionality* is not intentional* This survey reveals that intentionality* shares with intentionality at most only the properties of directedness and possible inexistence of the object, while intentionality* lacks the other marks of intentionality, namely intensionality, indeterminacy, extrinsicness, and direction of causation. Even in the case of possible inexistence, there are already reasons for thinking that the possible inexistence of intentionality* is unrelated to the possible inexistence associated with intentionality. It is clear that intentionality* is neither the same as nor a special case of intentionality.

One consequence of this is that we cannot, for the most part, recreate the philosophical problems of intentionality for intentionality*. Those problems are best seen by considering the fact that reflections on intentionality seem to pull us in opposite directions. On the one hand intentionality seems to be a relation between a thinker or thought and the object the thought is about. The externalism discussed above is the product of adding to this point of view the claim that the relation is (at least partially) constitutive of the content of the thought. On the other hand we have seen that intentionality is intensional. If intentionality really is a relation between thought and object, it is difficult to see how it could be intensional. For intensionality suggests sensitivity to a description or mode of presentation of an object, whereas the sorts of relation envisaged (such as a causal relation) are not sensitive in this way. Conversely, if intentionality is intensional, then it is difficult to see how it can be understood as any kind of relation. This problem is brought into especial focus when we consider the second manifestation of intensionality discussed above, that a thought can be directed towards a non-existent object. Nonetheless, intentionality cannot be understood in purely intensional terms, for that leaves unexplained the intentionality of indexical terms and fails to account for the non-intensional (externalist) intentionality of names and kind terms.

For the most part intentionality* does not share these problems since intentionality* differs from intentionality in the crucial respects mentioned. The intentionality* of basic potencies is not extrinsic. And intentionality* does not possess intensionality. Thus it is difficult to see how we can replicate the problems of intentionality for intentionality*—there seems no way of developing a parallel to the problematic tension between the relational and intensional characters of intentionality.

5.8 The manifest image

According to Wilfrid Sellars there is a deep tension between the manifest image—the way the world is as we experience it—and the scientific image—the way science tells us that the world is. Of course, in many cases the manifest image must just give way. We just should not believe that the Sun rotates around the Earth or that space is Euclidean. The manifest image is simply erroneous. But other cases are not so simple. The scientific image tells us that all matter is subject to the laws of nature which determine the behaviour of everything, except in those cases where the laws tell us that

the behaviour of items is fundamentally random at the deepest level. The manifest image tells us that our own behaviour is subject to reason and will. It seems to tell us that it is the outcome neither of deterministic laws nor of random processes.

Brian Ellis argues that essentialism about powers (potencies) can help reconcile these two images (2002: 139-144). For the version of the scientific image we work with and which is the origin of the tension in question, is a fundamentally Humean one. [99] According to Ellis, we must replace the picture of 'inanimate nature as intrinsically passive, and therefore as being *prima facie* incapable of acting, except under the influence of external forces' by one according to which 'the natural world is not intrinsically passive, but essentially active. It is a world in which all things have causal powers and are therefore agents of one kind or another. So the power of agency is not something unique to human beings, or other living creatures. It is a pervasive feature of reality.' Ellis goes on to explain what is distinctive about human agency. Some things just have powers without the possibility of changing them (such as the charge on an electron). Some can have their powers changed (such as an iron bar that becomes magnetized). Some can have their powers changed by exercise of their own powers, which we may term 'meta-powers'. Ellis argues that in deliberation we exercise such meta-powers that may induce a temporary power, whose manifestation is an action. 'A deliberate action is not just an event of a kind that regularly happens to follow when intentional states of mind of a certain kind come into being. It is something that is done *by the agent* as a result of an intentional state of mind that is itself brought about by the agent, namely by deliberation.'

I am in full agreement with Ellis's metaphysics of essentially dispositional powers, and agree that there is much wrong with Humean metaphysics of laws as regularities as well as the semi-Humean picture of Armstrong's of laws as contingent relations of nomic necessitation. Nonetheless, I do not agree that the differences between the metaphysics of powers and the others is what accounts for the tension between the manifest and scientific images. One can see this in complementary ways. Firstly, the Humean can say pretty well everything that Ellis says. If Ellis can reconcile the two images, then so can the Humean. Conversely, if the Humean cannot reconcile the two images, then neither can Ellis.

Let us look carefully at what Ellis's positive account says:

> (i) a deliberate action is something that is done *by the agent* as a result of an intentional state of mind;
> (ii) the intentional state of mind in (i) is itself brought about by the agent, namely by deliberation;
> (iii) a deliberate action is not just an event of a kind that regularly happens to follow when intentional states of mind of a certain kind come into being.

Since (iii) is a consequence of (i) and (ii) we can ignore it, so long as the Humean can account for (i) and (ii). Clearly the Humean can agree with (i). For a Humean can

[99] Similarly, Harré and Madden (1975: 1) argue that Humeanism leads to the 'impossibility of accounting for the common sense view of the world.'

assert the following: 'X is a deliberate action done by subject S only if X is caused by an intentional state of S's mind.' And by the same token the Humean can agree with (ii) that the agent herself brought about this intentional state by deliberation. The Humean can identify certain states of mind as deliberative and these can cause the relevant intentional states of mind.

Of course, the Humean has a different conception of causation from Ellis, and that conception may be inadequate for very deep and general metaphysical reasons. But those issues do not preclude a Humean from agreeing with the claims (i) and (ii). After all, Hume's own attempt to reconcile the scientific and manifest images is to differentiate between causes that are within the intentional states of the subject and those that are not. It would not be a metaphysically un-Humean step to add that the causes of the intentional states must themselves be intentional states of deliberation.

Similarly, the Humean can also agree that there is a hierarchy of dispositions: fixed dispositions, variables ones, and meta-dispositions. These all match Ellis's hierarchy of powers. The only difference again is at the level of general metaphysics. The difference is that the Humean thinks that the specific dispositional character of a property is contingent, the essentialist thinks it is necessary. But that difference itself seems to do no work in enabling the hierarchy to do the job of explaining what deliberate action is and how it differs from repulsion among electrons. If Ellis's hierarchy can provide that explanation, then so can the Humeans.

This is not to say that everyone will agree that Ellis *has* reconciled the manifest and scientific images. On the contrary, if one thinks that Humeanism has a problem of two images, then one ought to think that the metaphysics of potencies also has a problem of two images. With the new metaphysics one can say that the scientific image is an image whereby any state of the universe is a manifestation of essentially dispositional powers possessed by inanimate matter, except insofar as some aspects are the outcome of irreducibly probabilistic propensities. If one were previously worried by, for example, the problem of determinism and free will, talk of the universe being the manifestation of powers and propensities will not assuage those fears more than talk of the universe being the outcome of laws acting on things. Imagine, Laplace-like, that some scientist could measure the current state of some portion of the universe including all the micro-parts of my body so that she could using the laws of nature predict the position of my body twenty-four hours later, and she predicts that my body will be in a certain position in a Ye Olde Tea Shoppe in Chipping Camden. Some philosophers might feel that this thought is in deep tension with the sense I have that I can choose what to do with my body—I can deliberate and decide to get on a train to London or get on a plane to Edinburgh. But the tension doesn't depend on whether we describe the scientist as calculating the effect of the laws of nature acting on the micro-parts or we re-describe her as calculating the manifestation of the powers possessed by the same micro-parts. We could say that many of her calculations were a result of applying Coulomb's law to the charges possessed by electrons and protons; we could equally say that she calculated the manifestations of those charges in attractions and repulsions between the particles. But which description we choose should make no difference to whether we find (or not) a tension between

the picture of the state of the universe as being fixed, probabilistic considerations aside, by every earlier state of the universe and the picture of ourselves as agents able to think and choose.

So it seems that the metaphysics of powers has no advantage over the metaphysics of laws as regards dissolving any tension between the scientific and manifest images. But why then should Ellis be tempted into thinking that it might? The main reason, I think, is connected with a tempting way to picture the difference between the metaphysics of laws and the metaphysics of powers. The tempting picture is this. According to the metaphysics of laws, entities do not do anything of their own accord: they are just pushed and pulled around by the laws, which are in some sense extrinsic to them. But on the metaphysics of powers things do what they do by virtue of their powers to do things (which are intrinsic) and so are not pushed and pulled around at all. Then, if one reflects that we are made up of matter, the metaphysics of laws seems to tell us that the laws of nature push and pull us around (by pushing and pulling our material parts around). This seems in tension with the thought that we can typically decide what to do and are not pushed and pulled around like some shackled slave or puppet. Get rid of the metaphysics of laws and we get rid of the pushing and pulling around and hence get rid of the tension.

But the picture is highly misleading. Strictly, the metaphysics of laws does not tell us that the laws push and pull things around. The only pushing and pulling is done by one object on another, in virtue of the forces between them. To be sure, the forces exist in virtue of the laws, but that doesn't make it legitimate to talk of the laws doing any pushing or pulling. Imagine some object attached to a spring. We may explain its motion by the force exerted by the spring, a force governed by Hooke's law. But that doesn't make Hooke's law exert a force—it is only the spring that exerts a force. 'Pushing', 'pulling', 'exerting a force' are all causal notions. But on no metaphysics of laws do laws cause anything, although they may govern what causes what. No doubt, such talk is intended metaphorically and so not to have its usual causal implications. But those implications nonetheless make the metaphor a misleading one.

5.9 Conclusion

Potencies, if they exist, are essentially modal properties. Modal properties are suspect since they go beyond the actual into the realm of the merely possible. For it seems that the merely possible are non-things; they are not real, they do not exist. Allegedly, mere possibilia (such as unrealized manifestations of potencies) would be a violation of naturalism.

But these concerns do not impact on essentially modal properties, such as potencies, alone. They impact on any non-trivial modal features of the world. And unless one is a Megarian actualist then one thinks that the world does have modal features—for example, that laws do support counterfactuals. If the arguments here considered against potencies, the Too Much Potentiality argument in particular, were sound, they would spell trouble not only for the potency theorist but also for anyone who does not think that our modal claims are largely in error.

What has gone wrong? My diagnosis is that those worried by TMP are in the grip of a picture dominated by modal realism, according to which mere possibilia cannot exist with respect to the actual world but can exist with respect to other possible worlds. Thus if there are modal properties they must be cross-world properties. So it looks as if we are faced with a dilemma. If we accept modal properties we accept other possible worlds (viz. full-blown modal realism). But modal realism and the doctrine of other worlds are unattractive for a variety of reasons (from causal naturalism to the complex axiomatization and the dissonance between its object and metalanguages). On the other hand we may deny the existence of other possible worlds (viz. Megarian actualism) and be forced to reject the truth (except in trivially true cases) of modal including counterfactual claims.

The way of out the dilemma is to reject the picture offered by modal realism. Mere possibilia are not things that exist, if they exist at all, in other worlds but not in this one. The very statement 'mere possibilia are things that exist in other worlds but not in this one' is a contradiction if we accept that to exist is to be: x exists iff $\exists y(y{=}x)$. The latter thought should encourage us to shift from thinking in pictures and intuitions to reflection on the logic of modality. The simplest axiomatized quantified modal logic, and the one that allows a semantics where the object language and metalanguage are in harmony, is a logic in which the Barcan formula comes out true. The Barcan formula tells us that there are mere possibilia—there are entities that are possibly thus and so. (And so, again on the assumption that to be is to exist, mere possibilia exist.)

I do not doubt that the argument for mere possibilia is likely to be contentious. I should emphasize therefore that it is a digression to the extent that I do not regard it as required by dispositional essentialism in particular. Rather, anyone who believes in genuine modality but does not want to adopt full-blown modal realism faces a dilemma to which this is, in my view, the best response. But if you nonetheless prefer some other modal metaphysics, then that will be applicable to the dispositional essentialist view of properties and laws just as much as (or as little as) to a contingent nomic necessitation view plus categorical properties.

Thus the key part of this discussion is the *tu quoque* response to the modal problems raised for dispositional essentialism. Insofar as potencies entail the existence of unrealized manifestations so do categorical properties plus relations of nomic necessitation. There is no reason to take modal issues to be a disadvantage of dispositional essentialism relative to Armstrong's view. The same is true for regularity theorists so long as they agree that laws support counterfactuals. If not modal realists, then regularity theorists have the same problem of explaining where the unrealized consequent of a true counterfactual resides. If they adopt Lewis's modal realism, then they have bought into a metaphysical apparatus that would suffice to account for the unrealized manifestations of a potency.

And so we can bypass the problem of the existence of unrealized manifestations to the extent that it is not unique to dispositional essentialism; and we can accommodate it if we adopt the simplest quantified modal logic. But this does not exhaust the objections, since it was not only the existence of unrealized manifestations that

was problematic; the fact that potencies seemed to *point* to those manifestations was held to be objectionable too.

The thought that potencies possess something like intentionality is tempting. As Mumford has argued, this temptation is the result of an illusion. Careful consideration of what intentionality is, on the one hand, and of the essentially dispositional character of potencies, on the other, shows that there is no reason to assimilate the two. Consequently there is no argument against potencies on the ground that they share the problems of intentionality that require a reductive treatment. Equally there are no arguments in favour of them, that they explain intentionality or help reconcile the manifest and scientific images. To decide between essentially dispositional potencies and contingent laws we must depend on more general and fundamental metaphysical considerations alone.

6

THE REGRESS OBJECTION

In Chapter 5 I mentioned an argument against dispositional monism that I call the 'regress objection'. Dispositional essentialism takes the essences of properties to be given by some dispositional characterization, which mentions stimulus and manifestation conditions. Those conditions will be a matter of something's possessing or losing some property. Dispositional monism holds this to be true of *all* properties, including, therefore, the properties involved in the stimulus and manifestation conditions. It looks as if the essence of the first property involves at least two further properties, whose essences in turn involve yet further properties, and so on. There is thus an infinite regress of properties. Or, if not, it looks as if there must be some circularity somewhere. And the circularity may well seem to be vicious by analogy with other vicious circularities. For example, if one holds that all words had their meaning given by explicit definitions, then it is clear that the chains of definitions would have to be circular and that this circularity is vicious.

This is a rough and ready formulation of the regress/circularity objection. More needs to be said if it is to be a thoroughly convincing objection. In what follows I consider ways of making the objection more precise or at least explicit and will show how dispositional monism can be defended in each case. There are four *prima facie* plausible interpretations of the regress argument. One we have considered already, and that is the Too Little Actuality argument of Section 5.2. A second is Simon Blackburn's suggestion that there is strict incoherence involved in the resulting regress or circularity. A third is Richard Swinburne's epistemological argument. The fourth interpretation, which I take to be the most serious, is that the identity of potencies is indeterminate if there is regress or circularity.

6.1 Two unsuccessful regress arguments

6.1.1 *Incoherence*

Richard Holton (1999) takes the circularity objection as found in Blackburn (1990) to suggest that dispositional essentialism is strictly incoherent—that a putative world in which it is true would include an inconsistency. Holton does not mention circularity (or regress) *per se* but circularity can be a source of inconsistency, as Poincaré and Russell argued with respect to the semantic and class-theoretic paradoxes.

Let us assume for the sake of argument that dispositions are equivalent to counterfactuals. Then the consistency of the dispositional monist's view is a matter of assigning truth-values to a set Π of propositions at a set of worlds, such that each member of Π is equivalent to a counterfactual relating other members of Π. Holton provides such a simple model. Π is the set of propositions: P, Q, R, and S, where:

$P \equiv (R \mathrel{\Box\!\!\rightarrow} S)$ $\quad$ $R \equiv (P \mathrel{\Box\!\!\rightarrow} Q)$
$Q \equiv (S \mathrel{\Box\!\!\rightarrow} R)$ $\quad$ $S \equiv (Q \mathrel{\Box\!\!\rightarrow} P)$

The worlds in question, with the propositions true at them, are:

w_1: P, Q, R, S $\quad$ w_3: P, ¬Q, ¬R, S
w_2: ¬P, Q, R, ¬S $\quad$ w_4: ¬P, ¬Q, ¬R, ¬S

If the similarity of worlds is determined by the propositions true at them, then it is a simple matter to check that this is a consistent model. Hence there is nothing inherently incoherent, in the sense of leading to inconsistency, in the suggestion that all propositions should be counterfactuals. Thus there is no incoherence in supposing that all properties of things should be essentially dispositional.

While the concern that circularity might lead to incoherence is a reasonable one, it is not, I believe, at the heart of the objection. Armstrong (1997: 80) writes, for example, 'Can it be that everything is potency, and act is the mere shifting around of potencies? I would hesitate to say that this involves an actual contradiction. But it does seem to be a very counter-intuitive view.' Thus Armstrong at least does not consider the objection he has in mind to be that dispositional monism is incoherent in this strong sense.

6.1.2 *Swinburne's epistemological argument*

Richard Swinburne (1980: 316-19) offers a version of the circularity/regress argument that is epistemological in character. He concludes that if dispositional monism were correct, then we could not know what properties any thing has. Here is his argument:

> One can recognize that objects have powers only if one can recognize when such changes [the changes they are powers to produce] have occurred ... [T]o recognize that changes have occurred, one has to recognize properties. But if properties are nothing but potentialities for contributing to causal powers, we have a vicious infinite regress.

So Swinburne is not suggesting that the very idea of properties as potencies (powers) is incoherent. But rather that if it were true, we could never know any properties. Yet that is plainly false.

One might think that a plausible response would be that in some cases the manifestation of some property would be in the mind of the subject.[100] For example, if colours are dispositions, then a certain experience of colour might be the manifestation of that disposition. Indeed many dispositional accounts of colour take this to be so. Swinburne anticipates this response with two related objections. First, the phenomenal state of 'being appeared to redly' has more to its nature than just its causal role, as the inverted spectrum argument shows. Secondly, what we typically observe are not the properties of our sensations but the properties of things themselves. Swinburne goes on to say that in the latter case we can see straight away that

[100] This response is also considered by John Foster (1982: 70).

if all red objects were blue and vice versa and the causal roles of red and blue were swapped, the world would be genuinely different, even though its causal structure is unchanged. The second argument seems to be just a variant of the first, since the difference in the world after swapping red and blue and their causal roles is a difference in appearance. So just as in the inverted spectrum case, we are invited to consider worlds that are identical in their causal structure but different in phenomenal appearance.

Note first that the inverted spectrum argument, if sound, would be a direct refutation of dispositional monism, quite independently of the regress argument, and so needs to be addressed in its own right. To do so therefore takes us beyond the scope of the current discussion. That said, it is clear that the dispositional monist is far from being without resources to answer that problem. For it is precisely the same question as that which must be answered by a functionalist theory of mind (functionalism about the mind can be seen as an implementation of the subtheory obtained by restricting the domain of dispositional monism to the mental). Furthermore, if the argument is sound against functionalism it is sound against physicalism too. And in both cases the argument for the genuine possibility of inverted spectra from their intuitive plausibility is notoriously weak.

If we put the inverted spectrum argument on one side we can see that there is no epistemological regress problem. Let us imagine that a subject wants to know whether some object has property F, and therefore must come to know whether it manifests itself with property G, and so on, until she comes to property J. In the case of J, its manifestation is some property, K, of one of her mental states. Now K will also be dispositional, with manifestation property L, and so forth. But that latter fact is irrelevant from the epistemological point of view. If the mental property K is reliably brought about by J, then the subject's being in state K may itself be a state of knowledge (or belief that is justified) concerning the presence of property J. And there is no requirement that the subject additionally know (by detecting L) that she is in a state with property K. In general one can know without knowing that one knows (and likewise for justified belief). So simply being in K stops the regress, since the subject thereby knows about J, and thence about the preceding properties in the chain back to G and ultimately F. Such a view is consistent with a variety of claims about what K might be—a quale or phenomenal experience of some kind (understood functionally), a belief state, or a *sui generis* state of knowledge. And note that we can generalize this a little further. There may be intermediate states between J and K, so that the immediate manifestation of J is some I_1, whose manifestation is some I_2 and so forth, and where K is the manifestation of some I_n or some combination of Is. The Is might be brain states of the subject of which she is entirely ignorant. So long as the genuine mental property K is reliably related (via this chain) to J, then it is a possible candidate for a knowledge or belief state concerning J. Note therefore that J does not have to be a disposition whose *essential* manifestation is K. More generally, a property F can have effects that are not essential to it, even if they are necessarily connected; first because those effects further down the chain are not essential to F, and secondly because F can be the stimulus condition for D without that being part of F's essence—

though it will be part of D's essence. (We return to the latter point below.) According to various dispositional accounts of colour, it is the case that the essential manifestation of a colour property is a mental state concerning that property. But according to the view that a colour is essentially a spectral reflectance property its manifestation will be a complex of physical properties of light and so on. Most plausibly the instantiation of the original property F will have as a consequence, via chains such as those discussed, a brain state of the subject on which, in conjunction with environmental conditions, the knowledge state K concerning F supervenes.

I conclude that although Swinburne presents his argument as an epistemological regress argument, the regress in fact plays little forceful part. *Prima facie* it looks as if we are presented with an epistemological analogue of some more ontological regress argument. Potencies must have (potential) manifestations, which are themselves potencies, and so forth. Even if that regress may not be vicious, there is an epistemological problem that knowledge of a potency then requires knowledge of *its* manifestation, which is itself knowledge of a second potency, and so in turn requires knowledge of its manifestation, which is a third potency, and so forth. An infinitely descending chain of knowledge looks more obviously wrong than an infinite chain of properties. It therefore seems as if we can only know any property if this regress ends somewhere with a property which is not a potency but is something else, and colours or colour qualia seems instances of such non-potency, categorical properties. But in fact the epistemological chain can end with a property which while a potency is itself a state of knowledge (or other epistemic state) concerning other potencies. There is no further regress since there is no requirement that to be in a state of knowledge one must know that one is in such a state (likewise for other epistemic states). Consequently the only potentially troublesome part of Swinburne's objection is the entirely independent problem of the inverted spectrum.

6.2 Regress, circularity, and identity

The last *ad hominem* response from the dispositional essentialist claimed that the essential features attributed to the nature of a categorical property are a proper subset of those attributed to an essentially dispositional property (and hence the latter cannot have any less reality than the former). The categoricalist might respond that there is something that categorical properties are supposed to have that the essentially dispositional properties do not have, viz. primitive transworld identity—they are quiddities. The claim made by the dispositional essentialists is precisely that dispositional essentialists do not need primitive transworld identity, since transworld identity is secured by identity of dispositional character.

This remark does little to undermine the force of the *ad hominem* response. The possession or lack of primitive transworld identity conditions or any other kind of transworld identity conditions is not relevant to the reality of some entity in the actual world—it is relevant only to the question, which is the same entity in some other world? Thus this difference between essentially dispositional and categorical properties is not enough to give a reality to the latter that it withholds from the former. After all, Lewis does not regard primitive transworld identity as necessary for the reality of

particulars. Strictly his particulars have no transworld identity whatsoever. And his substitute for transworld identity, counterparts, is a qualitative theory of (pseudo-)transworld identity.

Nonetheless, the focus on identity does raise what I take to be the fourth and most important version of the circularity objection, viz. that identity of dispositional character is insufficient to account for transworld identity, within a dispositional monist approach. E. J. Lowe (2006: 138) does frame the regress objection in terms of identity, but does not provide any details beyond the following (original emphasis): 'The problem', he writes, '. . . is that *no property can get its identity fixed*, because each property owes its identity to another, which, in turn owes its identity to another—and so on, in a way that, very plausibly, generates either a vicious infinite regress or a vicious circle.' Howard Robinson's (1982: 114-15) version comes close to this, with a little more detail. Robinson argues from the premises (1) that every real object must possess a determinate nature, and (2) that the nature of a potency is given by its manifestation, to the intermediate conclusion that the determinacy of the nature of a potency depends on the determinacy of its manifestation. But this leads to regress, if the manifestation is always some new potency. An infinite sequence of manifestations constitutes indeterminacy. Hence if a potency is to be determinate, somewhere in the chain of manifestations we must come to one that is not itself a potency.

If, as I am inclined to do, we identify 'nature' and 'essence' and note that for the dispositional essentialist, essence determines identity, then Robinson's argument is pretty well that which I present below. There may those, however, who regard nature as distinct from either identity or essence, and these may regard metaphysical indeterminacy in nature as permissible. For example, one might hold that the nature of an entity can include contingent properties. Furthermore such properties may be vague, so, for example, it is part of the nature of Hera that she has brown eyes, and likewise for others. While it may be determinate for Hera that she has brown eyes, for Minerva it may not be determinate, since her eyes have a shade on the borderline between brown and green. The same goes for an endless range of other properties that are part of the contingent natures of entities. Hence such natures may be indeterminate. But even if we restrict our attention to essential properties the same problem arises. According to Kripke, one's species is an essential property. But the lesson of Darwinian evolution is that species boundaries are not determinate. Hence there will be creatures whose nature is not determinate. In which case Robinson's argument starts from a false premise. Those who take an epistemicist approach to vagueness will reject this conclusion. But even to those for whom indeterminate natures are permissible, the impermissibility of the indeterminacy of *identity* should be clear, thanks to Gareth Evans's (1978) argument that indeterminate identity violates Leibniz's law. Bearing in mind that for the requirement that identity be determinate is more obvious than the requirement that nature be determinate it will be more effective to present the regress argument in terms of the determinacy of identity rather than of nature.

Let us see, therefore, how something like Lowe's argument or Robinson's may be developed to show the indeterminacy of the identity of potencies. I shall follow Aris-

totle in taking the essence of an entity to be that whereby a thing is what it is (*Metaph.*, VII, 7). Thus we should expect the essence of a property, its dispositional character if it is an essentially dispositional property, to determine the identity of the property. According to the dispositional essentialist therefore, the essence of such a property is determined by its relations to other properties. And as we have discussed above, if one is a dispositional *monist* then those other properties also have dispositional essences. Consequently the identity of any property is determined by its relations to other properties. Hence, either there is an infinity of properties or there is circularity in this relationship of identities.

Either disjunct in this consequence of dispositional monism seems problematic. Consider the second disjunct, that the identity of a property is determined by its relationships with other properties whose identities are determined by their relationships with yet other properties, in a set of relationships which at some point returns to involve the very property we started with. The identity of that property is what this set of relationships was supposed to settle. Yet the nature of that set of relationships is dependent on identities of its relata, which *ex hypothesi* have not yet been settled.

This, I think, is the real problem of circularity that critics such as Lowe have in mind when they accuse dispositional monism of some kind of regress or circularity. Dispositional essences are relational—the essence of a property is a relation to other properties. If essences fix identity, as Aristotle says, then the identity of a property is determinate only if the properties to which its essence relates it themselves have determinate identity. And that is just what is ruled out by circularity.

The first disjunct provides little opportunity of escape. First, it is implausible that there are in fact infinitely many fundamental properties. The progressive unification of the laws of physics involves the reduction of the number of fundamental properties in the world. Secondly, the infinity of properties does little to remove the worry that the identity of any one property is not in fact determined. If one is worried that identity cannot be fixed by a circular set of relationships, then one will not regard an infinitely descending set of relationships as providing a solution. The circularity worry may be expressed thus. Saying that the identity of A is determined (in part) by B, can satisfy one that the identity of A is in fact determinate only to the extent that one is satisfied that B's identity is determinate. Likewise, the move from B to C will help only if C's identity is determinate. But if C's identity depends on A we cannot be satisfied that C's identity is determined, nor B's nor A's. Now consider the infinite case: C's identity depends on D, and D's on E and so forth without end, so that there is no point at which one can say 'X's identity depends on Y, and Y's identity is unproblematically determinate'. Just as in the finite but circular case, one has no reason for supposing the identity of any of the entities in question to be determinate. Infinite hierarchies need not always be looked on with suspicion. But as a rule of thumb an infinite hierarchy is benign only when its collapse into a finite structure is also benign. In this case to collapse the infinite structure we must suppose that at some point in traversing the structure, instead of being presented with new properties, we are presented with ones we have already come across. That is, the collapse of the infinite case is just the circular case, as one would expect. Thus if one thinks the cir-

cular case is troubling, the infinite case should be no relief. One way to see this is as follows: consider an attempt to fix the identity of A with a structure which turns out to be a circle with n elements, X_i being the i^{th} element and $X_1 = A$. Thus the identity of X_i depends on that of X_{i+1} and that of X_n on A. Let us add an $(n+1)^{th}$ element, X_{n+1} between X_n and A. Clearly that does not help matters, for although we can say that the identity of X_n is fixed by that of X_{n+1}, that only helps if the identity of X_{n+1} is fixed. And when we see that X_{n+1} has its identity fixed by A, the circularity objection bites. Adding in an element X_{n+2} will not help, nor an element X_{n+3}, and so on. Now let us consider adding in *infinitely* many elements after X_n. If we now traverse the list of dependencies starting at A, we will not reach A itself. But that hardly helps matters. The problem of the circle returning to A was not that the circularity led to some contradiction, but rather that the circularity seemed to show that our attempt to provide determinacy for the identity of A failed. And the infinite case fails to do so just as much as the finite, circular case.

6.2.1 *The advantages of categorical monism and the mixed view*

We can now see why categorical monism and the mixed view are perceived to have an advantage over dispositional monism. The matter is straightforward for categoricalism, for on that view the identity of categorical properties is primitive and so is primitively determinate. That is just what is meant by saying that they are quiddities. In the case of the mixed view many properties may well have dispositional essences. And so something like the structure of dependencies discussed above arises. The essences and so identities of some properties are dependent on those of others. But we are not required to regard such a structure as either circular or unending. This is because the structure can terminate in categorical properties. If we trace the chain of dependencies, from the essence of one essentially dispositional property to another we will eventually come across essentially dispositional properties whose manifestations or stimuli are characterized not in terms of yet further essentially dispositional properties but in categorical terms instead. Since these have their identities primitively, they serve to determine the identities of all the properties in the structure.

In the light of this, it might be asked why the believer in dispositionally essential properties does not accept the mixed view, which is the position adopted by Ellis (2002) and in a modified way by Heil (2003: 118). The principal reason is the disadvantages of quidditism mentioned above, which affect the mixed view as well as categorical monism. As it stands each view has its problems. But if the regress problem for dispositional monism can be resisted, then dispositional monism has a clear advantage. That it can be resisted I show in the next section.

6.3 Responding to the regress objection

I have described at some length the regress/circularity objection in the form that I take to be most pressing, in order to allow us to see what kind of response, if any, can be given by the defender of dispositional monism. Note what the objection has achieved and has not achieved. It has *not* shown that there is any inconsistency in the conjunctive claim that all properties have dispositional essences and those essences

suffice to determine the identities of those properties. Rather, it presents a challenge to the dispositional monist to show that this can be done. The argument, by referring to the circularity or infinite regress that would be involved, casts *prima facie* doubt on the ability of the dispositional monist to achieve this, while pointing out that the categorical monist and the mixed view can both meet the challenge without difficulty. I shall argue that the dispositional monist can meet the challenge, but that in so doing we see that the structure of properties and their essences must meet certain constraints.

To appreciate why dispositional monism can be defended, it is helpful to see that the challenge presented is an instance of a more general kind of problem. The dispositional monist wants the essences and hence the identities of her entities to be determined *relationally* rather than purely intrinsically (as is the case for categorical properties). In general the relational characterization of a set of entities faces the sort of challenge we have seen already. Indeed the problem is raised by Aristotle in the *Categories* where he rejects the idea that primary (and secondary) substances are relational. In effect Aristotle argues that all relations may be reduced to monadic properties of things, on the ground that a relation requires the distinctness of its relata—but that cannot be established by some further relation, since that further relation would require the distinctness of its own relata, and so on. Thus a regress ensues unless we ground these relations in monadic properties. I shall not pursue the exegetical question of whether Aristotle's argument is an analogue of the regress arguments considered above. But the position rejected certainly is an analogue of dispositional monism. Aristotle rejects the idea that all there could be to (the identity of) any *particular* is a matter of its relations to other particulars. Dispositional monism is the view that all there is to (the identity of) any property is a matter of its second-order relations to other properties. Aristotle's target is the first-order position of which dispositional monism is the second-order analogue. In dispositional monism the second-order relation in question is the relation that holds, in virtue of a property's essence, between that property and its manifestation property—which we will call the *manifestation relation*. In both cases, the thesis under discussion is this:

> (S) The identity and distinctness of the elements of a set E of entities supervene on the instantiations of some relation R (or set of relations $\{R_i\}$) on the elements of E.

The simplest case would be that where we are permitted just a single symmetrical relation R. Could a set of R-relations on E suffice to determine the identities of each element of E? The answer is *yes*. As Randall Dipert (1997) argues, this is just a simple question in graph theory. In graph theory we deal with a set of entities (*vertices* or *nodes*) and a single two-place relation among them (each instance of which is an *edge*), which is symmetric in the case of undirected graphs. The claim S then becomes:

> (S*) The identity and distinctness of the vertices of a graph can supervene on the structure of that graph.

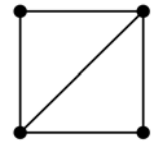

FIG. 6.1.

whether 'the structure of the graph' is just the pattern of the edges. (For the present I shall take it that we are interested in *relations between distinct entities*, so that the holding of a relation between an entity and itself is irrelevant to (S). We assume that the relation in question is irreflexive. As regards (S*), in graph-theoretic terms no vertex has a loop, although one could equally assume that the relation is reflexive and that all vertices have loops, in which case the presence of a loop add no information. For now graphs are *simple*.)

Clearly not *all* graphs can make (S*) true. Consider Fig. 6.1. It can be easily seen that a rotation of 180° will take all the vertices onto different vertices yet leave the structure unchanged. Consequently the structure of this graph fails to determine the identity of its vertices. A mapping whereby structure is preserved and at least some vertices are mapped onto different vertices is known as a *(non-trivial) automorphism*. We are looking for a graph that has *no* non-trivial automorphisms—i.e. an *asymmetric* graph. Such a graph would have no way of swapping vertices while leaving structure unchanged. Which is to say that the structure determines the identity of the vertices—the structure itself distinguishes each vertex from every other vertex; i.e. the identity of vertices supervenes on the set of instantiations of the edge relation. Are there then any graphs that have no non-trivial automorphisms? Yes, infinitely many. The simplest, trivial case is the graph consisting of a single vertex. The next simplest asymmetric graph has six vertices, as shown in Fig. 6.2. (This graph is a subgraph of all asymmetric six-vertex graphs.)

Dipert takes this to refute the Aristotelian claim. More generally we can see that it is possible for a set of instances of even a single symmetric relation to determine the identities of the various relata. Dipert was considering the first-order case, whether a first-order relation can determine the identity of particulars. Our case concerns whether a second-order relation (the manifestation relation) can determine the identity of first-order properties (potencies). John Heil (2003: 115) argues that since potencies are intrinsic to their possessors and because Dipert's world is purely rela-

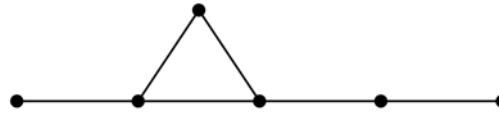

FIG. 6.2.

tional, there cannot be a world of pure potencies. But this is to confuse the first-order and the second-order cases. The dispositional monist, pure potencies view is not committed to all first-order properties being relational, i.e. it could consistently reject Dipert's view at the first-order level. Rather it asserts that the second-order analogue of Dipert's view is correct—potencies may have relational essences but nonetheless be intrinsic to their possessors. If we consider the manifestation relation to be a symmetric two-place relation, then our conclusion thus far would seem to be that a dispositional monist world consisting of potencies but no categorical properties is possible, but the number of distinct potencies is either one or more than five. That might appear to be an odd conclusion, but the thought that there might be just one fundamental natural property is not itself that strange. Physics shows success in reducing the number of *prima facie* fundamental laws and properties. There could be a single one. Of course that single property would be instantiated in a large number of different fundamental particulars, and it might be that different non-fundamenal properties correspond to different patterns of instantiation of the single fundamental property. The fact that there could not be two or three fundamental properties might seem rather more strange. But if we simply accept it is a mathematical consequence of the fact that the structure of the set of fundamental properties determines the identity of each, then it ought not appear objectionably strange. For we know that our intuitions about what is correct or reasonable in both physics and mathematics are not entirely reliable.

6.3.1 *Reflexive potencies and the asymmetric manifestation relation—loops and digraphs*

In fact we do not yet have to conclude that there cannot be two fundamental properties, because we have not yet added all the appropriate detail to our picture. The graph-theoretic conclusion holds given the following assumptions: (i) the graph is *simple*, which is to say that it contains no loops and no more than one edge between vertices; hence the manifestation relation is irreflexive and there is at most one way it is instantiated between properties; (ii) the graph is *undirected*, which is to say that the edges have no direction; hence the relation is symmetrical; (iii) edges are defined as *pairs* of vertices, not triples, quadruples, etc.; hence the manifestation relation is a two-place relation, not a three- or four-place relation, or any n-ary relation for $n > 2$. Arguably all of these assumptions are false: (i) It may well be that our graph should not have multiple edges, since there will not be more than one way a property can be the essential manifestation of another. But there is no reason to exclude loops—why should not some potencies be reflexive, i.e. the manifestation of an instance of D be another instantiation of D? (For example, in a macroscopic case: the dispositional state of being magnetic, instantiated in one piece of iron, may manifest itself by inducing a state of being magnetic in some other piece of iron.) (ii) Clearly the manifestation relation is not symmetric, for M may be the manifestation property of D without it being the case that D is the manifestation property of M. (iii) So far we have considered simply the relationship between a potency and its manifestation. But the nature or essence of a potency is often thought to be given not only by

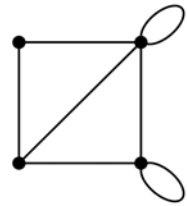

FIG. 6.3.

its possible manifestation but also by its stimulus. In which case we should be considering the three-place relation which holds between a potency, its characteristic stimulus, and its characteristic manifestation.

We'll put aside the complication raised by (iii) for the time being. The effect of our responses to (i) and (ii) is to make it much easier to find graphs without non-trivial automorphisms. Considering (i), adding a loop to a vertex may now distinguish it from one with which it previously had a symmetrical relationship. In Fig. 6.3 the graph from Fig. 6.1, which was symmetric, is now asymmetric thanks to the addition of loops. The edges in the graphs so far considered have no direction—the graphs are *undirected* graphs. But in *directed* graphs (*digraphs*) the edges do have a direction (and are called *arcs*), corresponding to asymmetrical relations. Clearly the asymmetrical arcs (edges with direction) add another source of asymmetry in a graph, as is shown in the asymmetric digraph in Fig. 6.4, whose underlying undirected graph is again the symmetric graph in Fig. 6.1.

Thus if we are consider that the fundamental properties are structured by the asymmetric, non-irreflexive relation between a potency and its essential manifestation property, then we can see that there could be any number of fundamental properties, represented by the vertices on directed graphs that may contain loops.

We should now check that we have answered the original regress problem. In short, the problem was that since each property's identity is determined by relation with a property, it seems as if we are faced with an infinite regress or a circularity, and this seemed to raise the question of whether the identity really is determined ('determinately') thereby. One aspect of this that we have not addressed is that each prop-

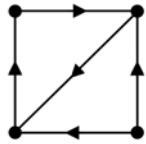

FIG. 6.4.

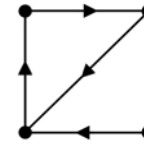

FIG. 6.5.

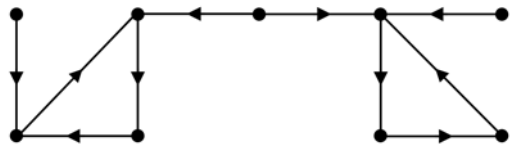

FIG. 6.6.

erty is determined by what *it does*.[101] Since an arc represents the relation between a property and the property that characterizes what it does, that amounts to the requirement that the graph representing the properties is such that each vertex has at least one arc incident from (leading away from) it. This constraint is not a particularly onerous one, and is satisfied, for example, by Fig. 6.4. It can be trivially satisfied if we allow loops. As is implicit in the statement of the regress problem, a finite solution is one that has circularity—or *cycles* in the terminology of graph theory, again as in Fig. 6.4. However, it is worth noting that infinite graphs can lack non-trivial automorphisms and so represent the determinate identity of the properties represented by its vertices.

6.3.2 *Further constraints*

Depending on one's view of the nature of potencies one may wish to add further constraints. For example, one might think that although non-fundamental dispositions may be multi-track—having a variety of distinct kinds of manifestation—the essences of fundamental properties should be single-track dispositions (cf. Section 2.2.1). This would require that for every vertex there is at most one arc incident from it. And so combined with the previous condition, we have that each vertex has precisely one arc incident from it. Fig. 6.4 does not satisfy this condition but its subgraph in Fig. 6.5 does.

By assuming that the *whole* graph contributes to determining the identity of its vertices, we are assuming, in effect, that the identity of a potency is determined not only by its manifestation property but also by any property of which *it* is the manifestation property. One might argue that this is a mistake. It may be necessary that M is the manifestation property of D, but that relationship need not be an *essential* characteristic of M (even though it will be an essential characteristic of D). What is essential to a potency is what it does—not what brings it about. In that case it would not be the whole graph that contributes to the identity of any vertex but is instead only that subgraph consisting just of those vertices and arcs lying on some directed *walk* (sequence of arcs) directed away from (and including) the vertex in question. Let us call such a subgraph a 'downstream' subgraph. So the criterion for determinacy of identity for vertices in a graph is that no two vertices should have isomor-

[101] This constraint is not met, for example, by the structure of properties and laws described by Hawthorne (2006: 220).

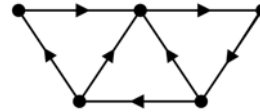

FIG. 6.7.

phic downstream subgraphs (excluding trivial automorphisms). This criterion—call it *strong asymmetry*—is not satisfied by the graph in Fig. 6.6. That graph is asymmetrical overall, but has several downstream subgraphs isomorphic to the graph in Fig. 6.5. Indeed the latter also fails the criterion; each of the vertices in the triangular cycle has the same downstream subgraph—the cycle itself. And so three vertices have downstream subgraphs that are isomorphic without being trivially automorphic. If a graph itself is asymmetric, a sufficient condition for strong asymmetry is that from every vertex there should be a directed walk that includes every other vertex. For if that condition is met, then the downstream subgraph for every vertex is just the whole graph, as is exemplified in Fig. 6.7.

Note, however, that the graph in Fig. 6.7 does not meet the condition imposed to ensure that potencies are single-track dispositions—several vertices have more than one arc incident from them. In fact no asymmetric digraph with more than one vertex can meet both these conditions, as is easily proved. Let a digraph have n vertices. Since there is precisely one arc incident from each vertex, the digraph has n arcs. Now assume also that from every vertex there is a directed walk that includes every other vertex. This implies that every vertex must have an arc incident to it. Since there are n vertices and n arcs, that in turn implies that each vertex has precisely one arc incident to it. So we conclude that every vertex has one arc incident from it and one arc incident to it, in which case the graph is a cycle graph (an n-agon, with the arcs all having the same sense), which is clearly symmetric, unless $n = 1$. Nonetheless, the condition that from every vertex there is a directed walk that includes every other vertex is only a sufficient condition for strong asymmetry, not a necessary one. And it is possible to satisfy that condition as well as all the others discussed so far, as is witnessed by the graph in Fig. 6.8.

6.3.3 *Essential stimuli*

I shall now turn to an issue raised already that concerns the stimuli of potencies. So far we have considered only the relationship between a potency and its manifestation property. But the dispositional essentialist maintains that a potency is not only

FIG. 6.8.

FIG. 6.9.

essentially a disposition to do something but is also essentially a disposition to do something in response to something else, the stimulus. Standard graph theory does not have the resources to capture this since its edges and arcs represent two-place relations whereas we now need to represent the three-place relation between disposition, stimulus, and manifestation. However we may adapt it by having two kinds of arc, one for the manifestation relation and another for the stimulus relation, the latter represented by a white arrow (see Fig. 6.9). (Note that the direction of an arrow represents ontological dependence, not causation.) To show that the two relations belong together as part of the same three-place relation, we may use arcs with different hatching. Arcs with the same hatching belong together. But this is merely a labelling device—differently hatched arcs are not different kinds of arc.

As the graphs in Fig. 6.10 show, it is possible to satisfy the desiderata discussed above; in particular:

> (i) Each vertex has a single black-arrowed arc and a single white-arrowed arc incident from it, representing single-track dispositions with unique stimuli.
> (ii) The graphs are (a) asymmetric, and (b) such that each vertex's downstream subgraph is the whole graph, and thus are strongly asymmetric. This ensures the achievement of our goal, that in a system of pure potencies, each potency can have its identity determined uniquely by its essential relations with other potencies.

6.4 Conclusion

All natural properties are essentially dispositional—what each property is depends on its essential relationship with its manifestation. Since the latter is a matter of instantiating a further property, we are faced with a regress of infinitely many properties or circularity. While this problem has been raised for dispositional monism by

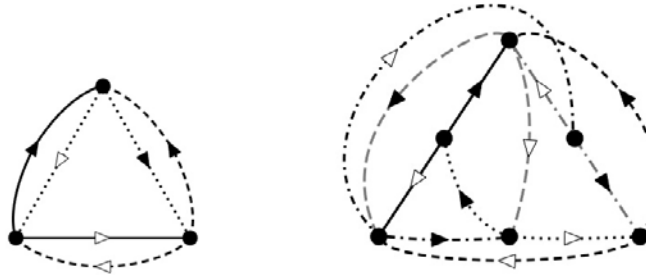

FIG. 6.10.

a number of authors, there has been little agreement on exactly why this regress is problematic. Holton takes Blackburn to regard it as involving a contradiction. Swinburne's version of the problem is couched in epistemological terms, although Armstrong refers to it in his metaphysical rejection of dispositional monism. As it is, these objections are easily defeated. Lowe and Robinson come closest to what I regard as the most pressing form of the objection, viz. that the regress raises some doubt as to whether *identity* is determinate for pure potencies.

Once the objection is couched in these terms it is clearer what would be required to address the problem satisfactorily. For the dispositional monist identity of properties is dependent on something else, rather than being primitive (the latter view being quidditism). The something else is the pattern of manifestation relations. The question may be phrased then, Can the identity of potencies supervene on the pattern of their manifestation relations? The answer is that it can.[102] If we represent the manifestation relation by edges of a graph and the potencies by its vertices, that question is represented by the graph-theoretic question: Can a graph be asymmetric? This is because in an asymmetric graph, one which lacks non-trivial automorphisms, the identity of the vertices supervenes on the structure of graph, as fixed by the pattern of edges. To represent satisfactorily various metaphysical characteristics of the manifestation relation (e.g. that it is asymmetric, that it holds once between any pair of potencies, that it is not irreflexive, etc.) we may put various constraints on the graph. Furthermore, we need to add to the normal graph-theoretic machinery to represent the stimulus relation also. Nonetheless, once all these constraints and additions are taken into account, it remains the case that there are graphs that represent possible structures of pure potencies that have the property that the identity and distinctness of the vertices supervene on the structure of manifestation and stimulus relations. We may confidently conclude therefore that the regress objection can be answered. There may be structures of potencies that are circular (or that involve infinitely many potencies) but that is no obstacle to the identities of those potencies being fully determined by the asymmetric pattern of those structures.

[102] The problem addressed here can be thought of as an instance of a more general one, whether identity criteria can be *impredicative*. Thus Davidson's (1969) criterion of identity for events, viz. that events are identical that have the same causes and effects (which are themselves events), has been criticized on this ground by Lowe (1989*a*), Strawson (1976), and Quine (1985). For a revealing discussion of impredicative identity criteria in the same spirit as the above see Horsten (2006).

7

STRUCTURAL PROPERTIES

In this chapter I shall examine the challenge to dispositional essentialism that is presented by natural properties that seem not to be potencies (nor reducible to them) and are held up as paradigms of categorical properties. These are structural, typically geometrical properties. By 'structural properties' I mean properties required to account for the structure of things and to explain those things that are explained by the fact that things have structure or are related in a structured manner.[103] Take the science of crystallography. The explanation of the properties of a crystal will refer to its structure, which is a matter of the geometrical relations of the ions or molecules that constitute the crystal. Since spatial relations are structural in the current sense, all sciences will depend on structural properties. A categoricalist might think that an object that consists of a set of masses in a particular spatial configuration has just been described in purely categorical terms. Whether dispositional essentialism can account for mass may be up for debate. But the present, greater challenge is to account for the spatial relations in dispositional terms.

In Section 4.1 I defined categoricalism, (CM), as the the view that all natural properties are categorical properties, whereas dispositional monism, (DM) (Section 3.1.1), says that all fundamental natural properties are potencies. This left room for (MV), the mixed view. The latter is a dualistic view of properties, holding that some fundamental natural properties have dispositional essences while others are categorical. The challenge to be faced in this chapter is that some fundamental natural properties seem not to be potencies. Being triangular, for example, seems to bring with it no powers in the way that, say, being negatively charged does; it seems inappropriate to characterize that property in dispositional terms. If that were the case, we would be impelled to give up (DM) in favour of at least (MV).[104] That would be damaging to several central claims of this book. (Although, not to all. For one could still be a dispositional essentialist as regards the source of *all* laws. Categorical properties could

[103] Note that in talking of 'structural' properties I am referring to something somewhat different from (but related to) the structural universals discussed by Lewis (1986*a*), Armstrong (1978*b*), and Bigelow and Pargetter (1989). Nor am I discussing properties as may be conceived of by structuralists of various kinds. A structuralist may maintain that all there is to some set of entities is the set of more or less formal relations between them. On such a view the essence of a property might just be its relations with other properties. Certainly dispositional monism should be regarded as a structuralist account of properties in that sense—cf. Chapter 6; Hawthorne (2006) calls dispositional monism 'causal structuralism' for this reason. But I am not begging the question in this chapter by thinking of 'structural' properties in this sense; rather, they are the properties of objects that exist in virtue of their spatial relations or in virtue of the spatial relations of their parts.

[104] Brian Ellis (2005) makes the objection that structural properties must be categorical on behalf of the mixed view. A similar point is made by George Molnar (2003).

feature in the stimulus and manifestation conditions of potencies, and so could figure in our laws, even if all the laws were generated by potencies. The mixed view of properties although dualist about properties does not imply dualism about laws (cf. Section 3.1.3).) Nonetheless, my arguments in Section 4.2 imply that no properties are categorical.[105] In which case, how might one defend the claim that structural properties are, despite appearances, potencies also? As in the objection concerning the alleged contingency of laws (see Chapter 8), the dispositional monist must argue that appearances are deceptive. It is not the case that fundamental structural properties do not have dispositional essences.

An old debate between Hugh Mellor and Elizabeth Prior provides a useful starting point in the search for dispositional essences for structural properties. That debate was initiated by Mellor's (1974: 157) claim that dispositions should not be regarded as 'shameful in many eyes as pregnant spinsters used to be—ideally to be explained away, or entitled by a shotgun wedding to take the name of some decently real categorical property.' The supposedly shameful mark of a disposition is that it entails a subjunctive conditional. Mellor argued that this trait was shared by supposedly proper categorical properties too. Specifically he argued that '*x* is triangular' entails such a conditional. Elizabeth Prior (1982), on the other hand, argues that Mellor's alleged entailment does not hold. While the motivation for that debate is not identical to that behind this chapter, we can make use of it for our purposes. For if Mellor is right, and we cannot distinguish between dispositional and categorical properties on the basis of their relationship to subjunctive conditionals (because both have such a relationship), then it would appear to follow that there are not really any genuinely categorical properties after all. Allegedly categorical properties, such as structural properties, are potencies after all.

In this chapter I shall first see whether we can use this debate in the service of dispositional monism. My conclusion is that while it does not establish dispositional monism, it does help undermine the view that structural properties are clearly categorical. I then turn to more general grounds, based in recent developments in physics, for thinking that fundamental structural properties such as spatial displacement should have dispositional essences of this kind. I shall argue that our intuition that spatial and temporal properties and relations are categorical is a consequence of our thinking of spacetime as a background to our physical theories and not as an agent or patient of physical causes and effects. Whereas if we follow the lead of certain physicists in demanding that our theories should be background-free, then the way is open to thinking that structural properties do have dispositional essences.

7.1 The Mellor–Prior debate

As we have seen in Chapter 2, disposition talk has traditionally been cashed out in terms of entailing a counterfactual or subjunctive conditional. The debate we are about to consider turns on this. Whether or not structural properties are potencies,

[105] In Section 4.2.3 I showed why these properties do not somehow escape the objections to categoricalism.

according to this debate, is a matter of whether those properties are appropriately related to those conditionals. This would seem to provide a test for whether a property is a potency or is a categorical property. However, thanks to the problem of finks and antidotes, application of the test is not as simple as it might at first appear.

7.1.1 *Testing for potency*

Let us recall the (simple) conditional analysis of dispositions:

> (CA) *x* is disposed to manifest M in response to stimulus S iff were *x* to undergo S *x* would yield manifestation M.

Since potencies are defined as natural properties with dispositional essences, (CA) yields the following necessary condition on being a potency:

> (P→) If P is a potency then for some S and M and for all *x*: P*x* entails (if S*x* were the case, then M*x* would be the case).

Categorical properties, by contrast, have no non-trivial modal characters:[106]

> (C→) If P is a categorical property then there are no S and M such that for all *x*: P*x* entails (if S*x* were the case, then M*x* would be the case).

If some property does entail a non-trivial conditional then by (C→) it is not a categorical property. But (P→) does not show that the property is a potency. For that we would need also:

> (P←) P is a potency if for some S and M, and for all *x*: P*x* entails (if S*x* were the case, then M*x* would be the case).

(P←) is contentious. For one thing X may entail Y without Y being part of X's essence (Fine 1994), even if the entailment is non-trivial. For example, 'being made of gold' is not a potency; nonetheless, via the necessity of constitution, it entails having subatomic parts that are positively charged (the atomic nuclei and their protons). And since, according to the dispositional essentialist, being positively charged is a potency, '*x* is made of gold' will entail a non-trivial modal conditional, for example 'if the subatomic components of *x* are individually placed in an electric field, then some of them will experience a force in the direction of the field'. Thus the dispositional essentialist will hold that some properties are not potencies but are nonetheless related to potencies in such a way that they too entail modal conditionals. Even ignoring the claims of dispositional essentialism, the argument of Section 8.2 shows that it is a non-trivial necessary truth that salt dissolves in water. Hence '*x* is salt' non-trivially entails 'were *x* placed in water, it would dissolve'. But being salt is not itself a potency. This line of thought may also seem to put (C→) in question. However, if we restrict ourselves to fundamental properties, these concerns disappear. Fundamental properties will be either categorical properties or potencies. If that is right then we may write:

[106] The qualification 'non-trivial' is supposed to exclude, for example, necessarily true conditionals that are entailed by every proposition.

(P↔) A fundamental property P is a potency iff for some S and M and for all *x*:
P*x* entails (if S*x* were the case, then M*x* would be the case);

(C↔) A fundamental property P is a categorical property iff there are no S and M such that for all *x*:
P*x* entails (if S*x* were the case, then M*x* would be the case).

(P↔) and (C↔) provide a test whereby we may decide whether a given fundamental property is a potency or is categorical. Here we are concerned with structural properties, so let it be agreed that P is a fundamental structural property. We then consider whether '*x* is P' entails some non-trivial subjunctive conditional. If it does not, then we may conclude, via (P→), that P is not a potency, and, via (C←), that it is a categorical property. P would provide a counterexample to (DM), the claim that all properties are potencies. On the other hand, if '*x* is P' does entail a subjunctive conditional, then P is a potency and not a categorical property. Thus P cannot be employed as a counterexample to (DM); on the contrary, P would be a counterexample to the claim (CM), that all properties are categorical.

The challenge presented to dispositional monism by the property of triangularity and its like is that it seems to satisfy (C↔) and not (P↔). If so dispositional monism is in error. An immediate response would be that we have limited our attention in those principles to fundamental properties, and 'triangularity' as such does not seem to be fundamental. Even if fundamental entities might exemplify this property, one would not expect 'triangular' to be a predicate in some final physics. Nonetheless, the kind of challenge presented remains. Whatever the fundamental spatial relations are, they would be like triangularity, one might suppose, in not having dispositional essences. If the fundamental spatial relations are potencies, then we would expect a relatively simple derived property such as triangularity to inherit the capacity to entail subjunctive conditionals. Hence the lack of any such entailment would indirectly support the claim that the fundamental spatial properties are categorical. Conversely, if we can find a non-trivial conditional entailed by '*x* is triangular', then the best explanation of this is that the fundamental spatial properties are potencies. An alternative explanation would be one of the kind referred to above and discussed in 8.2, where the entailment trades on a non-trivial necessity that exists independently of dispositional essences. But such an explanation seems implausible in this case. For these reasons it is instructive as regards fundamental properties to reflect on the status of triangularity.

7.1.2 *Complications for the conditional test for potency*

Thus far it seems that we have simple test based on (P↔) and (C↔) for whether triangularity is a potency or a categorical property. However, matters are more complex, for two reasons. The first notes that 'A' may seem to entail 'B' when a *de dicto* reading of the sentence 'A' is given, but not under a *de re* reading. Hence we need to be careful which we are employing when applying the conditional test. The second reminds us of the problem of finks and antidotes.

7.1.2.1 De re *entailment* Success for Mellor's claim does not necessarily vindicate the dispositional essentialist view. The categoricalist can endorse the claim that some statements asserting the instantiation of a categorical property do entail a conditional. The categoricalist acknowledges that there are dispositional property terms, such as 'elastic', 'irascible' and so forth. The meanings of these terms, says the categoricalist, may well be conveyed by subjunctive conditionals. Hence there might well be some conditional C such that '*x* is elastic' entails C. But that will not show that the property we call 'elasticity' is essentially dispositional. As I discussed in Section 3.1.1 there is a categorical-dispositional distinction for properties and for predicates, and these need not match up.

There are several ways one can construe the reference of expressions of the form 'the disposition to M when S' ('$\mathsf{D}_{(S,M)}$'—where the sans-serif 'D' is used to indicate that '$\mathsf{D}_{(S,M)}$' is a singular term, not the predicate '$D_{(S,M)}$'). They are:

(i) '$\mathsf{D}_{(S,M)}$' names a property—the property of being-disposed-to-M-when-S. According to this view, in all possible worlds objects with the property $\mathsf{D}_{(S,M)}$ are disposed to M when S. Within this view we may take two very different approaches. (a) In the first two sentences of this paragraph 'the property' means 'the sparse property'; (b) 'the property' means 'the abundant property'. If (a) then '$\mathsf{D}_{(S,M)}$' names a potency. If (b) then it seems that '$\mathsf{D}_{(S,M)}$' names an abundant property. But it isn't clear what it is to name an abundant property. One might reify abundant properties, as entities akin to Fregean concepts. Or one might regard naming an abundant property as being equivalent, in effect, to a simple predication. That is, '*x* has the property $\mathsf{D}_{(S,M)}$' is equivalent to '*x* is $D_{(S,M)}$'.

(ii) '$\mathsf{D}_{(S,M)}$' is a definite description, equivalent to 'the (sparse) property that is responsible for something's being disposed to M when S'. The categoricalist will regard the sparse property thus picked out as being a categorical property. That property will have a contingent dispositional character thanks to the laws of nature of this world. The description will pick out different categorical properties in different possible worlds. In another world the description will pick out a possibly different property that, thanks to the possibly different laws of that world, contingently has this dispositional character (to M when S) in that world. The dispositional monist will take this description to pick out a potency (if it picks out any sparse property)—and the same potency in all worlds (the one whose essence is to M when S).

(iii) '$\mathsf{D}_{(S,M)}$' is a rigidified definite description, equivalent to 'that (sparse) property that is *actually* responsible for something's being disposed to M when S'. According to the dispositional essentialist, that property is a potency, and so this is equivalent, as far as the modal characteristics of reference are concerned, to (i)(a). The categoricalist will regard this rigidified definite description as picking out a categorical property. As in (ii) that property will have a contingent dispositional character thanks to the laws of nature of this world. However, in this case, the expression picks out that same categorical property in each possible world, and so in some other possible worlds objects with that property will not be disposed to M when S. The dispositional monist will regard the rigidification as making no difference relative to the

non-rigidified description in (ii), since if a potency actually has some dispositional character, that very same property has that character, to M when S, in all worlds.

(iv) '$\mathsf{D}_{(S,M)}$' names a second-order property—the property of possessing some first-order property responsible for something's being disposed to M when S. Again the second-order property might be a sparse or an abundant one. An important issue here is whether there are any sparse second-order properties of this kind. They do not appear to have any distinctive explanatory power. There is, I think, one area where this might not be the case, and that is the area of evolved complex systems. A creature's visual system will have evolved not because of its specific underlying first-order structure but because of its function. The same selection processes might have (and will have in other creatures) brought about the evolution of systems with quite different underlying structures but with the same functionality. Ecologically, therefore, it would be the higher-order property that has explanatory value rather than the diversity of first-order properties (cf. Vicente 2002, 2004). Clearly, however, such cases do not impinge on the current concern with fundamental and near fundamental structural properties. If the second-order property is an abundant property, then '*x* has the property $\mathsf{D}_{(S,M)}$' is equivalent to a predication: '*x* has some first-order property that is responsible for something's being disposed to M when S'.

Of these I'll ignore (iv) and (i). According to (iv), if '$\mathsf{D}_{(S,M)}$' does refer to a sparse property, it is not the sort of sparse property we are dealing with (since it is then a non-fundamental property of a complex system). Otherwise, '$\mathsf{D}_{(S,M)}$' doesn't refer to a sparse property (it refers to an abundant property or is equivalent to a predication involving quantification over properties). If the reading of the term is such that it does not refer to a sparse property, then we are obliged to ignore that reading as irrelevant, since the conditional test is a test of sparse properties, not of predication. Similarly we can ignore (i)(b). Reading (i)(a) is already to judge that reference is to an essentially dispositional sparse property, and hence begs the question that we are applying the test to answer.

So we are left with readings (ii) and (iii). Which of these we choose will affect what we think is entailed by '*x* has the property $\mathsf{D}_{(S,M)}$'. Crucially, if we choose (ii), the categoricalist will agree that in all possible worlds, if *x* has the property $\mathsf{D}_{(S,M)}$ then were *x* to receive stimulus S then *x* would manifest M. In which case the conditional test will not distinguish between categorical properties and potencies. On the other hand, if we choose (iii), the test can make the required distinction. If the property picked out by the rigidified definite description is a potency it will have the same subjunctive character in all possible worlds, whereas if the property is a categorical one, it will not.

This is of course what we want—we want to test for the modal characteristics of one and the same property across possible worlds. In other terms, when testing whether '*x* has $\mathsf{D}_{(S,M)}$' entails '$Sx \mathrel{\Box\!\!\rightarrow} Mx$' we need to ensure that the former is understood *de re* rather than *de dicto*.

7.1.2.2 *Finks and antidotes again* The second complication for the test of potency notes that its founding principles, (P↔) and (C↔), are derived from (CA). And as we

have seen we have reason to believe that (CA) is false—in both directions of the biconditional in (CA). Given (P→), the truth of Mellor's claim is necessary for the truth of dispositional essentialism in this sense. There must be some conditional entailed by '*x* is triangular'; if there is not, triangularity is a counterexample to (DM). (Of course, Mellor's particular conditional might not be the right one—we shall return to this.) But if (P→) is false, then the non-existence of such a conditional will not show that triangularity is non-dispositional. And (P→) does indeed seem to be false. (P→) is derived from the definitional claim that potencies have dispositional essences plus the left-to-right implication in (CA), (CA→): $D_{(S,M)}x \rightarrow (Sx \,\Box\!\!\rightarrow Mx)$. As we saw in Section 2.2.2 finks and antidotes present counterexamples to (CA→). Thus the existence of finks and antidotes means that the conditional test is not definitive, in that a potency need not entail a subjunctive conditional after all.

7.1.3 *Rules of the debate*

Should the conclusion of the previous section be that the truth of subjunctive conditionals is a red herring as regards testing for potency? No, I think not—but we should be careful. There is, as Charlie Martin has said, clearly some sort of connection between dispositions and conditionals, even if it is not one of straightforward entailment (Armstrong *et al.* 1996: 178). So the debate can proceed, only we need to ensure that the problems identified are not exploited. On the one hand, we need to ensure that circumstances involving finks and antidotes are not employed to show that a structural property is not a potency. On the other hand, *de dicto* entailments may not be used to show that a property is a potency. That is, we must ensure that any entailment claim holds in virtue of a *de re* reading, because only the *de re* reading ensures that we are testing for the modal characteristics (i.e. those relating to the subjunctive conditional) of one and the same property across possible worlds. Put another way, we want the entailment to reflect the metaphysics of the properties, not the merely analytic features of the terms used to denote them

Thus the debate should be governed by two rules:

> Rule 1: Any alleged entailment between the possession of a property and a subjunctive conditional should hold in virtue of a *de re* reading of the former claim; more generally, any link established between a property and a conditional must be a metaphysical rather than a merely analytic one.
>
> Rule 2: The existence of a link between a property and a conditional may not be refuted by appeal to finks or antidotes (or established by appeal to finks or mimics).[107]

With these rules or caveats in place we may use the conditional test, i.e. the existence or otherwise of a relation between properties and conditionals, to decide

[107] One could reformulate the conditional analysis (CA) so as to exclude finks and antidotes, and so remove the need for Rule 2. This is in effect what Mellor (2000) proposes. It is contentious whether the reformulation still constitutes an analysis. Either way it is more convenient for the following discussion, but equivalent to Mellor's proposal, to keep the simple conditional analysis and to exclude finks, antidotes, and mimics via Rule 2.

whether a structural property such as triangularity is a potency or a categorical property.

7.2 The case of triangularity

The challenge to the dispositional monist is the claim that geometrical shape entails nothing as regards counterfactual or subjunctive conditionals. There is no C, it is asserted, such that C is a genuine, non-trivial, modal conditional and '*x* is triangular' entails C. Mellor, however, states that there is just such a C. His candidate is 'if someone were to count *x*'s corners correctly, then the result would be three'. That is, he asserts:

> (T) That *x* is triangular entails that if someone were to count *x*'s corners correctly, then the result would be three.

Hence triangularity is at least no proven counterexample to dispositional monism. (C↔) does not show that triangularity is a categorical property. And to the extent that (P↔) can be relied upon, (T) seems to show that triangularity is a potency.

The subsequent debate hinged on the interpretation of 'correctly'. Prior held that Mellor's claim acquired *prima facie* plausibility only because of the use of this word. For without it we would see that the entailment does not hold—people frequently count things and get the wrong answer. More significantly, we are entitled to consider another possible world in which the laws of nature are different so that its inhabitants make systematic errors in counting. (Prior suggests perceptual errors, but one could imagine deeper neurophysiological interference also.) The inclusion of 'correctly' is significant because it seems to rule out such cases. But, says, Prior, it does so only because we take the claim that a task was carried out 'correctly' as meaning that it was performed successfully, that it got the right result. Since it is analytic that triangles have three corners, it is also analytic that someone who counts the corners of a triangle correctly gets the answer three. And so the entailment does not seem to reflect the metaphysics of the property of being a triangle. Rather it depends only on analytic relations and so Mellor's argument falls foul of Rule 1.

Prior (1982) notes that Mellor states in a footnote that 'correctly' is intended to refer not to the result of counting but rather to the manner of counting. But she thinks that if this is so, then the entailment fails, since if it is only the manner of counting that is invoked, then counting in the unusual world with systematic error may be carried out in the correct manner without getting the correct result.

Prior has a second argument that invokes a different unusual world, in which the laws of nature are such that when one starts to count the corners of a triangular object, the object is caused to change the number of corners it has. Hence, if one counts as well as one can one will get an answer other than three.

What defence has Mellor against these two objections? He does not address the second. But he does not need to. For it is clear that in the world considered, triangularity is finkish, in that the stimulus, counting, causes an object to lose its triangularity. Consequently, this objection to the entailment contravenes Rule 2 and may be ignored.

As regards the first objection, here the accusation is that Mellor has broken Rule 1. Mellor responds that he can spell out precisely what counting correctly is without referring to the correctness of the result: it is to count the items in question once each (and once only), which is to put them in a '1-1 correspondence with an initial segment of the sequence of positive integers 1, 2, 3 .... The highest number in the segment is the result of the counting' (Mellor 1982: 97). Does this reply block Prior's appeal to Rule 1?

Let us compare '*x* is even', which entails 'if *x* were to be divided by 2, then the result would be an integer'. On one understanding, where dividing is understood as an abstract mathematical operation, this is clearly true. Does this make 'being even' a dispositional property? If so, it would be difficult to deny that being triangular or any other property is dispositional. If Mellor's claim is understood analogously, with 'counting correctly' taken to be an abstract mathematical operation, it might well be regarded as analytically trivial, and so outlawed by Rule 1. It is analytic that the set of corners of any triangle has three members. It is analytic that when any three-membered set is put into 1-1 correspondence with an initial segment of the positive integers, the highest number in the segment is three. So Mellor's entailment is analytic. But is it *merely* analytic?

As we have seen, the distinction between a merely analytic entailment and one that reflects the metaphysics of the entities involved is the distinction between an entailment that holds *de dicto* only and one that holds *de re*. Thus if the entailment is not merely analytic it should continue to hold when we employ any rigid designator to pick out the entity in question. So 'S is the inventor of bifocals *entails* S invented bifocals' is a merely analytic entailment, since 'S is Benjamin Franklin' does not entail 'S invented bifocals'. While even if one thought that being H_2O is part of the definition of water, '*x* is water entails *x* is H_2O' would not be merely analytic, since, for example, '*x* is that substance which, in the actual world, is the main component of living things on earth entails *x* is H_2O' is also true (but not analytically).

By this test Mellor's entailment will not come out as merely analytic, since for any rigid designator 'D' that picks out the property of triangularity, '*x* is D' entails 'if someone were to count *x*'s corners correctly, then the result would be three' (where 'counting correctly' is still understood abstractly). Yet we should note that the efficacy of the way of distinguishing merely analytic and metaphysical relations depends on the difference in modal properties between definite descriptions and rigid designators. But there is no such difference between mathematical definite descriptions and corresponding rigid designators. So the test does not seem to be applicable here, and it is not clear that Mellor's entailment does not infringe Rule 1.

However, a different reason for dismissing Mellor's claim, on this understanding, is that it is in conflict with the thought that the stimulus of a disposition is a cause of the manifestation—dropping the fragile vase caused it to break, pulling the elastic caused it to stretch, and so forth. Although this is contentious in the eyes of some, we could add a third rule. Rule 3 would state that there must be a causal or nomic connection between the antecedent of the conditional and its consequent. Mellor's claim would be outlawed by Rule 3 on the mathematical interpretation.

On the other hand, we might understand the operation of dividing as an intellectual, psychological operation, not as an abstract mathematical one. This allows the stimulus (i.e. dividing) to cause the manifestation (getting an integer as the answer). If we regard the process of counting the corners of the triangle in this way, then Mellor's claim looks to be a substantial one. However, we might then ask, can we be sure that his entailment holds under this interpretation? One might argue on Prior's behalf that it does not. For now there is a gap between the fact of the corners of the triangle having been correlated with the set of numbers {1, 2, 3} and the fact of the subject's being in the mental state of getting the answer three. In normal cases this gap is traversed without difficulty. But in unusual cases it need not be. Where environmental conditions or the laws of neurophysiology are different, the counting may have been carried out correctly, the appropriate correlations having been made, yet the answer achieved is a number other than three. For example, we may imagine a 'killer triangle' whose particular size and angles interact with a subject's neurophysiology to kill them instantly or to cause mental aberration. Or we could take the case of a triangle painted Kripke's killer yellow (cf. Lewis 1997: 145).

Hence, the conditional is not entailed by the ascription of triangularity. However, this does not prove that Prior is right. We already know that in general disposition ascriptions do not entail the corresponding conditional, because of finks and antidotes. We saw that Prior's case of a world where triangles ceased to be triangles when counting began is an invocation of a fink. The cases considered in the previous paragraph do not invoke finks (the triangles remain the same), but they do involve antidotes, since they interfere with the normal operation of the stimulus. Hence this response breaks Rule 2 again.

As we shall see, the debate is by no means concluded. Nonetheless, at this point Mellor's claim that triangularity is no less related to its conditional than potencies in general are related to theirs, has not been refuted.

7.2.1 *Locating dispositions*

The debate is not concluded since one might reject Mellor's entailment as proving that triangularity is a potency on the following ground. While the entailment discussed seems to indicate a dispositional character *somewhere*, it is not, on reflection, clear that the character lies with the triangle rather than the counter. Consider the following:

> (N) S is a normal observer *entails* if S were to count the corners of a triangle correctly then S would get the answer three.

Modulo finks and antidotes, this seems to be true. Given the link between dispositions and conditionals upon which we have been trading, this suggests that 'normal observer' is at least a dispositional concept, which is plausible enough. Note however that this entailment is equivalent to (T), if finks are excluded. So it looks as if we have two dispositions for the price of one. In this case the entailment is perhaps *de dicto* rather than *de re*. Nonetheless, the question is raised, whether it isn't the dispositionality of the concept of 'normal observer' that is doing the work in generating the conditional (T).

It is worth noting, as Martin does (Armstrong *et al.* 1996: 135-6), that dispositions frequently come in pairs of 'reciprocal disposition partners'. The negatively charged electron is disposed to attract the positively charged proton; the proton is disposed to be attracted to the electron (and also to attract the electron towards it). In fact our discussion suggests that dispositional concepts might always come in reciprocal pairs. For the following are typically equivalent:[108]

> X *entails* were it the case that Y, then Z would be the case; and
> Y *entails* were it the case that X, then Z would be the case.

So it seems too hasty, simply because there is dispositionality in the subject (the counter), to exclude triangularity from having the dispositional nature that makes it a potency. However, the resulting position remains unsatisfactory from the points of view of both the categoricalist and the dispositional monist. On the one hand the dispositional reciprocity between the triangle and the observer that is suggested by Mellor's account makes triangularity look like a secondary property, akin to a colour. But there is a clear disanalogy between structural properties such as triangularity and secondary properties such as colour, in that the latter have an explanatory role only in a limited portion of science, primarily the behavioural sciences. That is as it should be, since the manifestations of colours and all other secondary properties are the mental states of sentient observers. Yet structural properties play a role at the most general and basic level in science. And their doing so is independent of any power to produce effects in human observers. This does not show but does suggest that the reciprocity between triangle and observer is one-sided, that the dispositionality comes primarily or even completely from the observer and not from the triangle.

Furthermore, the same line of reasoning will suggest to the dispositional monist that Mellor's conditional does not show which potency triangularity is. The existence of a property may be related to a wide range of conditionals. But not all of them reflect the essence or nature of that property.[109] In this case (T) seems to make being triangular a secondary property, a property whose nature is to be a disposition to cause a certain effect in a human observer. One can deny that triangularity is a secondary property without asserting that it is a categorical property. Perhaps it should be understood as a genuinely tertiary property, one that is a disposition which is manifested not in human subjects especially but in some other, broader, class of entities, a class specifiable at a more general level in science.

[108] But, as Hawthorne and Manley (2005: 185) appear not to notice, these entailments are not equivalent simpliciter (cf. Bird 2003*b*: 163 and Cross 2005: 336-7). The following *are* equivalent: $X \vDash (X\&Y \mathrel{\Box\!\!\rightarrow} Z)$ and $Y \vDash (Y\&X \mathrel{\Box\!\!\rightarrow} Z)$. So the non-equivalence between $X \vDash (Y \mathrel{\Box\!\!\rightarrow} Z)$ and $Y \vDash (X \mathrel{\Box\!\!\rightarrow} Z)$ arises thanks to worlds (taking the first entailment) such as w: at w X holds but at the nearest world to w where Y holds, X does not hold. Now in the cases we are considering, X will be a statement asserting that a dispositional property holds and Y asserts that some stimulus property holds. Thus at w the disposition exists but at the nearest world where the stimulus exists, the disposition does not—i.e. the dispositional property in question is finkish.

[109] Thus the equivalence, modulo finks, of the two conditionals may indicate that dispositional *concepts* come in reciprocal pairs, but does not suggest that dispositional *essences* come in such pairs.

Insofar as we are still employing subjunctive conditionals as a sign of dispositionality, we should look for a conditional that reflects the nature of the (alleged) disposition, and a sign of this will be that the stimulus and manifestation reflect the role of the property in scientific explanation. In effect, both sides should accept this as Rule 4. Triangles may exist in pretty well any possible world that has a physical component. It would be odd, if triangularity is a potency, that it should be one whose dispositional essence, if it can be specified, is specifiable only in terms of entities (things that can count) that exist at a very limited range of possible worlds. Rule 4 says that if triangularity is to be shown to be genuinely essentially dispositional, we should look for a conditional characterization that has appropriate generality.

We should look therefore for a much greater level of generality in trying to understand what kind of potencies structural properties are. I shall outline two ways of achieving this. The first approaches this question head on and seeks an appropriately general conditional. The second approach is more oblique and makes us ask why we expect that the sparse structural properties of physics should be thought to be categorical. The answer is that in classical physics these properties characterize a *background*. But contemporary physics seeks background-free theories, in which the structural properties do have powers.

7.2.2 *Properties and geometries*

Plausibly there are conditionals for structural properties that come much closer to obeying Rule 4 than (T). Sungho Choi has suggested to me that we could generalize the notion of counting corners. All we would need is a counting machine that can distinguish travelling along a geodesic from not doing so. If it did not do so at any point, then it would add one. Such a machine, travelling along a triangular path, starting at any non-apex point, would count to three on returning to its starting position. Even so, one might hope to find an essence constituted out of properties that one might expect to find in a fundamental theory. In Bird (2003*b*) I suggested the following as a starting point:

> (T) The paths AB, BC, and AC form a triangle *entails* if a signal S travels along AB then immediately along BC, and a signal S* travels along AC, starting at the same time and travelling at the same speed, then S* will reach C before S.

The problem I raised for this suggestion was that this is false for many non-Euclidean triangles. I therefore proposed that the following is true (again barring finks and antidotes):

> (T_E) The paths AB, BC, and AC form a Euclidean triangle *entails* if a signal S travels along AB then immediately along BC, and a signal S* travels along AC, starting at the same time and travelling at the same speed, then S* will reach C before S.

One could then regard 'triangle' as ambiguous, or generic, across a range of triangle properties, each for different kinds of geometry, and each of which has a different essence of this kind. I suggested triangles in Riemannian geometry or Lobatchevsky-

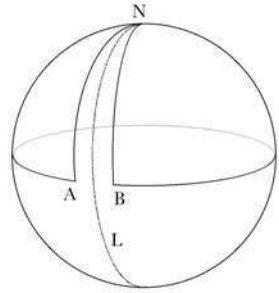

FIG. 7.1.

Bolyai geometry might have different (T_i), although in fact (T) will do for many geometrical contexts. In spherical geometry one may consider the figure whose vertices are the north pole, N, and two nearby points, A and B, on the equator and whose sides are the longitudinal arcs NA and NB and the equatorial arc AB that goes the long way round the equator (see Fig. 7.1). AB is a little less than $2\pi \times$NA, and so the signal (such as a pulse of light) along AB will take longer to reach B than the signal passing from A to N and thence to B. Whether this counts as a counterexample to (T) rather depends on the definition of 'straight line' in the context of defining a triangle as a 'figure with three vertices joined by straight lines'. For if a straight line is the *shortest* path between two points, the longer part of the great circle will not be a straight line and our figure is not a triangle, and so no counterexample to (T).[110] On the other hand, if we remove from the sphere the points other than N on a line of longitude that passes through the narrow gap between A and B, then our figure is a counterexample. On this view, there is no (sparse) property of triangularity in general. Triangularity is a portmanteau term covering different kinds of triangularity. The different kinds have dispositional essences relating to some variant on (T). It is (T) and its family of variants that define triangularity in general.

One drawback for this approach is that it does not demonstrate that the dispositional monist is correct. For where the latter sees a specific and allegedly dispositional property ('being a Euclidean triangle') the categoricalist will see a conjunctive property consisting of a general categorical property plus a specification of the space it is in ('being a triangle in Euclidean space'). The approach considered does not show that the former is correct, at most only that is it is an option. (That may be enough for the dispositional monist given that the properties in question are raised as counterexamples.)

It is in any case far from clear that there is some clearly defined family of variants on (T) that will pick out all and only the triangles in various geometries. Furthermore, it seems a rather convoluted way of characterizing something that can

[110] But one could define a straight line as the set of points $L = \{a + tb; t \in S\}$ where a and b are vectors and S is a closed segment of $\mathbb{R}$. In which case both great circle paths are straight lines between A and B.

be so easily defined in non-dispositional terms ('a closed figure bounded by three straight line segments'). The Mellor–Prior debate was about whether being triangular entailed any subjunctive conditional, and happened to focus on one concerning the counting of vertices. But such a conditional would never have sufficed to characterize the essence of triangularity, if triangularity has an essence that is sufficient for something's being a triangle, because many figures have three vertices that are not triangles (not having straight edges). Rather better than either Mellor's suggestion or my (T) is the following:

> The straight line segments AB, BC, and AC form a triangle *entails* were a signal to pass along AB it would not pass through C (and similarly for the other two permutations of A, B, and C).[111]

Even so, I am inclined to think that such conditionals fail to get at the heart of the problem, for two reasons. First, it is difficult to see that anything like a causal or nomic role is being assigned to triangularity. In Bird (2003*b*) I claimed that the connection is causal, while admitting that this could be disputed. I am now less sure. The mere fact of (T) being a counterfactual may confer a spurious appearance of causality. I don't take counterfactuals to be definitive (*à la* Lewis) of causality. A dispositional essentialist could accept a Lewisian account of causality and add that the counterfactuals arise because of the presence of dispositions. However, it would then seem to make sense to cut out the middle man, counterfactuals, and to regard causal relations as instances of dispositional relations. There is in any case good reason to do so, since *both* the counterfactual analysis of causation and the counterfactual analysis of dispositions have counterexamples. Perhaps both sets of counterexamples could be eliminated by bypassing counterfactuals altogether?

Matters are, however, not quite so simple. The counterfactual analysis of the basic causal relation is: C causes E iff $\neg C \Box\!\!\rightarrow \neg E$. However, the most obvious dispositional analysis of causation says that C causes E iff E is the manifestation of some disposition whose stimulus is C. If we apply the simple conditional analysis of dispositions to this, we have: C causes E iff $C \Box\!\!\rightarrow E$ & C & E.[112] This reveals a contrast: whereas Lewis's counterfactual analysis of causation focuses on (counterfactually) *necessary* conditions, the dispositional analysis identifies causation with *sufficient* conditions. (A dispositional account of causation suggests that Lewis's approach, along with Hume's claim from which it originates, was misguided from the very start.)

We should remember, furthermore, that 'triangular' is unlikely itself to name a fundamental structural property, and the dispositional essentialist is therefore not required to find a dispositional essence for it. The dispositional monist ought instead to focus attention on the fundamental structural (primarily spatial and temporal) properties and argue that these have dispositional essences.

[111] This derives from a suggestion made by Philip Welch.

[112] Note that we need an analysis of counterfactuals for which C&E does not suffice for $C \Box\!\!\rightarrow E$—which it does according to Lewis and Stalnaker. But we need this in any case if the counterfactual analysis of dispositions is to be acceptable. Nozick's treatment of counterfactuals, for example, is such that C&E does not entail $C \Box\!\!\rightarrow E$.

7.3 Background-free physical theories

I will now sketch an alternative view of how dispositional essentialism may be reconciled with structural properties at the fundamental level. I shall concentrate on spatial separation (displacement), but the argument carries over to temporal relations also. Our knowledge of the nature of space and time is in a state of flux and we do not know what the role of fundamental spatial and temporal properties will be in the final theory of everything. Note that it is not *a priori* that such a theory would refer to spatial and temporal properties at all, nor, if it does, that the fundamental ones neatly mirror the role of such properties in folk physics or even classical physics.

Nonetheless, we can make some prognostications that suggest that a final theory would treat all fundamental properties dispositionally. I will first mention a brief response by Stephen Mumford (2004: 188) to the current problem. The gravitational force on an object is sensitive to both the masses of it and of other massy objects and its displacement from those other objects; looking at Newton's law: $F = Gm_1m_2/r^2$, the force F is a function of the masses m_1 and m_2 and also of their displacement r. Mathematically speaking mass and displacement are on a par—there is no way for Newton's law itself to distinguish between the two quantities as regards dispositional (causal or nomic) priority. In which case why should we not regard the force as a manifestation of the displacement, in which case displacement is characterized dispositionally: the displacement r between two points is the disposition whose manifestation, when masses m_1 and m_2 are located at the points, is a force between those masses with magnitude $F = Gm_1m_2/r^2$?

While I think this is along the right lines, it needs supplementation. There are two issues to be addressed. First, we need some explanation as to why it seems so much more natural to regard the force as a manifestation of the masses rather than of their displacement. Speaking figuratively we are inclined to think of the force as being generated by the masses, not by their displacement. Secondly, displacement crops up not just in the law of gravitation, but also in Coulomb's law and elsewhere. Thus it would appear that we could characterize displacement dispositionally with respect to a variety of different and seemingly independent manifestations. If so, then either (i) displacement is a multi-track disposition (one with more than one kind of manifestation); or (ii) one of these manifestations (e.g. gravitational rather than electric force) is privileged over the others.

7.3.1 *Displacement as a multi-track disposition*

The problem with regarding displacement as a multi-track disposition is that multi-track dispositions are not pure dispositions (see Section 2.2.1. The conjunction of two dispositional essences is not itself a dispositional essence, just as the conjunction of two counterfactuals is not itself a counterfactual. So we are unable to characterize the nature of displacement in terms of *a* dispositional essence. The dispositional essentialist is required to see such properties such as displacement as non-fundamental (along with paradigm multi-track dispositions such as the ability to speak French).

This conclusion is not itself inevitably problematic—it is not *a priori* that spatio-temporal properties and relations are fundamental. But it would mean that the de-

bate is off. If they are not fundamental properties, then having dispositional essences or not does not directly bear on the truth of dispositional monism. As already remarked, it is the fundamental properties and relations that are held to be essentially dispositional. If it turns out that spatial separation is not a fundamental relation but supervenes on some other as yet unknown property or relation, then spatial separation provides no counterexample to dispositional monism and an investigation by inspection of whether the truly fundamental properties and relations are essentially dispositional must await further developments in physics.

The alternative is to regard one of the dispositions as privileged in characterizing the essence of displacement, and given the general theory of relativity it is natural to see gravitational force as participating in the essence of spatial properties and relations. If we do take this view, the first question remains to be addressed. Why do we tend not to regard gravitational effects as *equally* the effect of displacement as of mass? This question is significant, because if we are right not to regard spatial displacement as causally efficacious (or more loosely as a potential agent) then displacement cannot be characterized with a dispositional essence.

7.3.2 *Background structures and substantivalism versus relationalism*

In order to respond to that question, we must take a short detour via our conceptions of space and time, in particular the view of the nature of space (and time) associated with the conception of spatial properties as causally inert. The classical conception of spacetime has been that of a stage or container within which things and laws act, but which is not itself involved in the action. It is a mere background. As such, although space and time are a part of the natural world, they are certainly not patients, that is to say recipients of effects, in any cause-and-effect relation, or more generally subject to change according to natural law. Their status as causes or agents of law-governed change is ambivalent. On the one hand, terms for spatial and temporal dimensions appear in the laws. On the other hand, we do not classically regard these terms as indicating action on the part of space and time. One reason for this is what Harvey Brown (Anandan and Brown 1995, Brown and Pooley 2006) among others calls the 'action–reaction' principle. Something can only be an agent if it is also a potential patient; something may only be a cause if it is also potentially the recipient of effects. According to substantivalism spacetime is a background *entity*, and so the displacement r between two objects is only indirectly a relation between them. It is primarily a relation between spacetime points. The objects inherit that relation by being located at spacetime points that are a distance r apart. On the classical view the structure of spacetime is also fixed and unchanging. Since spacetime points do not change their relations with one another, it is difficult to see how they and their properties can contribute causally to the behaviour of objects located in spacetime. Thus the displacement r between spacetime points is inert, and so, in consequence, is the supervening displacement r between the objects.

In the light of the forgoing, the relationalist, non-substantivalist conception of spacetime ought to be more congenial to the dispositional monist. On the simplest version of this view spatial relations are directly relations between objects (not be-

tween spacetime points). This reverses the absolutist/substantivalist view according to which relations between object supervene on relations between spacetime points. The relationalist takes all the facts concerning space and time to supervene on facts about relations between objects. The laws of nature mention only spatial and temporal *relations* and these can be accounted for. They are at least in a position to obey the action–reaction principle, since spatial relations appear both as sources of change (e.g. in the gravitational law) and as objects of change (as in Newton's second law). Since space and time just are the sum of spatial and temporal relations, there is nothing more to be explained than has been explained. While it hasn't yet been shown that spatial relations really are agents of change, the possibility is now open that they are.

The obvious problem with the simple relational view is that it fails to account for the full range of spatio-temporal possibility. There seem to be times and places where objects and events could be but are not. Hence Leibniz extends the set of relations to both actual and possible spatio-temporal relations. But then we must ask, what grounds such possibility? Furthermore the set of spatio-temporal relations is found to have a metric structure and we may ask for an explanation of that fact too. If spatial and temporal relations are fundamental, then we should expect them, according to a dispositional essentialist view of their essences, to generate the laws that underlie the structure of spacetime, including facts about its metric.

In classical physics understood in an absolutist, substantivalist sense, however, this seems not to be the case. We have discussed that fact that laws such as Newton's law of gravitation and Coulomb's law *mention* spatial relations. These laws cannot be serious candidates for expressions of the essence of spatial relations since they tell us nothing about the structure of space. They tell us how the magnitudes of forces of certain kinds depend on spatial relations. But they do not tell us what spatial relations are possible and they do not tell us what metric the set of points in space possesses. It is telling that one response to this is conventionalism about spacetime, *à la* Poincaré, Schlick, or Duhem, for example. According to views of this sort, a choice of geometry and metric is conventional. We typically choose our geometry in such a way as to make the laws of physics expressible in a convenient form. The choice does not reflect some fact concerning the real structure of space and time, there being no facts of that sort. While one is not obliged by classical physics to be a conventionalist about the geometry of space and time, the fact that conventionalism is an option shows that no laws in classical physics determine that geometry. Either way, whether one prefers Newtonian substantivalism or conventionalism, there is no room for laws of the sort (ones telling us about the structure of spacetime) that the dispositional essentialist about spatial and temporal properties seeks.

In summary the dilemma is this. The general problem in classical physics is that relationalism posits too little structure, not enough to explain empirically revealed aspects of space and time, while substantivalism posits too much, and in particular makes spacetime a background structure. Scientifically, there is a problem in not having enough structure—excess structure is preferable. From the metaphysical point of view (that of the dispositional monist at least) matters are reversed. The thinner commitments of relationalism are *prima facie* acceptable. If space is nothing

but the spatial relations between objects, then we do have a law telling us how space changes, Newton's second law. On the other hand, if impelled by the requirements of physics to posit more structure, so that space is the fixed structure of spatial points, not the changeable structure of objects, then we have introduced a mere background that is not subject to any law. Such background structures of substantivalism, being inert, cannot be accommodated within the dispositional essentialist viewpoint.

7.3.3 *Dispositional essences and background-free physical theories*

In a dispute between physicists and metaphysicians, it would be wise to take the side of the physicist. And so the preceding discussion might seem to put dispositional monism at a disadvantage. Recently, however, physicists such as John Baez (2001), Lee Smolin (1991), and Carlo Rovelli (1997) have advocated the view that a good physical theory should be background-free. Thus either space and time should be eliminated from our theories (although an unlikely prospect, this is not impossible). Or they should be shown not to be merely background. Either way the grounds for spatial and temporal properties and relations being clear exceptions to dispositional monism would be removed—in the first case because the properties no longer figure in fundamental science at all, and so are not fundamental, natural properties; and in the second case because space and time would no longer be mere background but instead are fully fledged agents, capable of acting and being acted upon. This would permit spatial and temporal properties to be understood dispositionally.

It should be noted, however, that the motivation behind the drive for background-free physical theories is not exactly the same as that which seeks dispositional fundamental properties. In causal terms, the latter is concerned to show how space and time can be genuine causes. While spatial and temporal relations occur in physical laws, they seem, as presented classically, not to be entirely genuine causes. But the search for background-free theories is principally a matter of showing how space and time can be *affected* by other causes.

Let us put this a little more precisely. The dispositional essentialist wants the following to be true of any fundamental spatio-temporal property or relation P:

> P has a dispositional essence, viz. P can be characterized in terms of some stimulus and manifestation, S and M, such that it is essential to P that if Px, then (*ceteris paribus*) Sx $\Box\!\!\rightarrow$ Mx.

The problem is that although we may be able to find an entailed counterfactual for certain spatio-temporal properties, it is unclear that this must be seen as flowing from the essence of those properties. One reason for this is that when:

(A) Qx entails Sx $\Box\!\!\rightarrow$ Mx

it is typically also true that:[113]

(B) Sx entails Qx $\Box\!\!\rightarrow$ Mx

Thus if (A) shows us the essence of Q, it looks as if we have another entailment of a counterfactual, (B), which seems to indicate the essence of S. We should not exclude

[113] Typically, but not always; cf. footnote 108.

the possibility that (A) and (B) both characterize the essences of Q and S respectively, in which case they are instances of Martin's reciprocal disposition partners. Equally we should not assume automatically that (A) and (B) do both characterize the essences of Q and S. And in certain cases there seems to be an asymmetry; our initial problem was that the relationships between the various sources of force (mass, charge, etc.) and displacement seem to be examples of such an asymmetry.

I take it that something such as the following characterizes what is meant by a background:

> If K is a background structure in a theory T, then
>
> > (i) K is not subject to change and is not affected by changes elsewhere;
> > (ii) the laws of T refer to properties and relations of elements of K or properties and relations defined on K.

It is the first clause, in particular the phrase 'not affected by changes elsewhere' that characterizes the 'backness' as it were of the background.

The claim therefore that theories should be background-free, or that there is no background, is tantamount to saying:

> (B-F) In a true theory, any structure appearing in the laws of that theory is subject to being affected by changes elsewhere.

Thus, if L is a structure in a true theory T, then for certain stimuli S, the following is true:

> (C) S $\Box\!\!\rightarrow$ a change in L.

Does (C) help the dispositional monist, where L is spacetime? The dispositional monist seeks dispositional essences for spatial and temporal properties. If (C) provides them, then the essences of the spatio-temporal properties in question are such that under certain stimuli the structure of spacetime is itself changed. Now this is somewhat different from what we started looking for, which was spatio-temporal properties being responsible for changes rather than spacetime being the recipient of change. Nonetheless, (C) *could* do perfectly well in providing a dispositional essence. We may distinguish *active* from *passive* dispositions; active dispositions are those that have manifestation in entities other than the possessor of the disposition, while passive dispositions have manifestations in the possessor of the disposition. Some favourite dispositions, such as fragility, are passive.

In general, however, the manifestation of a disposition should be of a kind such that it can itself be responsible for changes. Otherwise we would find that the properties in question are merely epiphenomenal. In the case of (C) that means that changes in L (here spacetime) must themselves be capable of being responsible for changes of certain kinds. If so, those dispositions may be the ones most appropriately regarded as the essences of spatio-temporal properties. Nonetheless, (C), even if it does not constitute a solution to our problem, can show how our concerns may be addressed. One reason why it is difficult to see space and time as causes on a classical substantivalist conception, is that it is difficult to see them as in any way being effects. The

background is unchanging. But if it is unchanging how can it generate any effects? On the other hand, if it is subject to change, then it is easier to see how it might itself be a cause of change. According to the action–reaction principle, something is a potential cause only if it is a potential effect also. Thus (C), which reflects the requirement of background-freedom, (B-F), tells us that spacetime and its properties may be affected by changes elsewhere; and the action–reaction principle tells us that since spacetime and its properties may be the recipients of change they may also be causes of it. In dispositional essentialist terms, we can see that by being potential manifestations of dispositional essences, spatial and temporal properties may also have dispositional essences themselves.

That perspective is precisely that endorsed by General Relativity. Each spacetime point is characterized by its dynamical properties, i.e. its disposition to affect the kinetic properties of an object at that point, captured in the gravitational field tensor at that point. The mass of each object is its disposition to change the curvature of spacetime, that is to change the dynamical properties of each spacetime point. Hence all the relevant explanatory properties in this set-up may be characterized dispositionally. And furthermore, this relationship helps address the second question raised above, by explaining why gravity is privileged over other forces in characterizing the essence of spatial relations.

7.4 Extrinsic structural properties?

Molnar (2003: 158-62) argues that some structural properties cannot be potencies because they are extrinsic properties. Thus the spatial position of an object is, Molnar argues, extrinsic since it is a relation between an object and spacetime. But extrinsic properties cannot be potencies. So spatial position is not intrinsic.

One could resist this argument by rejecting the premise that potencies are always intrinsic. After all, as McKitrick (2003) has shown, not all dispositions are intrinsic. Nonetheless, I maintained above that McKitrick's argument does not refute the more restricted claim that sparse dispositions are intrinsic. A better line of attack is to argue that the properties in question are either not fundamental or are intrinsic after all. For example, one might argue, for the reasons relating to relationalism about spacetime or the acceptance of background-freedom, that spatial position as conceived by Molnar is not fundamental whereas spatial displacement, considered as a direct relation between objects, is fundamental. In which case the relevant question is whether displacement is an intrinsic or an extrinsic relation. The latter question is not entirely straightforward, since discussions of intrinsicness typically focus on monadic properties of individuals, rather than on dyadic relations among pairs of individuals. Nonetheless, the idea of intrinsicness is extendible. To say that Jack and Jill are lovers implies nothing about the existence of anything else, but to say that they are co-authors implies the existence of some third thing, the work they wrote together.

The details of the analysis of intrinsicness are still under debate. The intuitive idea is that the possession of intrinsic properties should not depend on what else there is. One way to spell this out is in terms of independence of accompaniment: there can be an F that is lonely; there can be an F that is accompanied; there can

a non-F that is lonely; and there can be a non-F that is accompanied (Langton and Lewis 1998). A similar but nonetheless distinct approach is to take the world with the object in question and to contract (or expand) it by removing (or adding) objects; if the property can remain despite contraction or expansion then the property is intrinsic (Vallentyne 1997, Yablo 1999). Lastly, one might appeal to the idea that perfect duplicates share intrinsic properties (Lewis 1983*a*: 111). (In fact Langton and Lewis need to combine the first and third approaches in their account.) Spatial displacement comes out as intrinsic on the first and second approaches. It does seem to fail on the third, since we could duplicate two objects without placing them the same distance apart. But the third approach is little use to an account of intrinsicness that covers dyadic properties, since a dyadic property of a pair of objects will be retained by their duplicates only if it supervenes on those properties retained by the duplicates individually; i.e. on this approach a relation is intrinsic only if it supervenes on intrinsic monadic properties of its relata.

I think that even Molnar's spatial position comes out as intrinsic. Arguably an object can be in the place that it is independently of accompaniment and independently of any contraction or expansion of its world. A relationalist might question whether the position of another object is independent of other things. But then the relationalist should deny that position is fundamental—separation is. Molnar thinks that position is extrinsic because it is a relational property. But it is an error to infer extrinsicality from a property's being relational (Weatherson 2006). Position is a relational property, according to Molnar, since it involves a relation between the object and spacetime. But that will make position extrinsic only if the existence of spacetime is independent of the object. A material object has to exist in spacetime—a lonely material object is not one that exists outside space; it's the only thing in space. Once again, the duplication approach gives a different answer since duplicates do not have to be in the same place. However, we may in any case regard the duplication approach as too restrictive with its attributions of intrinsicness: being Socrates would not be an intrinsic property of Socrates; nor is the property of undergoing a change whereby some part is exchanged for a duplicate of that part.

7.5 Conclusion

If spatial and temporal properties and relations are fundamental natural properties and relations, then the dispositional monist must provide reasons for thinking, contrary to a common intuition, that they too have dispositional essences. One approach is to take a familiar geometrical property (such as triangularity) and show that its instantiation entails some counterfactual. But ultimately this turns out to be indecisive. The dispositional monist will expect dispositional essences to be reflected in the laws of nature. And since triangularity is not a fundamental property of the kind that appears in the laws of nature, strictly speaking it is irrelevant to the dispositional monist's argument, in that it is not the sort of example that would provide a coun-

terexample to the claim that *fundamental* sparse properties are essentially dispositional.[114]

We looked therefore at the seemingly basic property of spatial separation and its relationship to the laws of nature. On a classical substantivalist conception of space, spatial separation is a relationship between points in an unchanging spatial background, and thus incapable of acting as a cause, and so also incapable of having a dispositional essence. A relationalist conception of space may seem more accommodating to dispositional monism, but was scientifically problematic in the classical era. Nonetheless contemporary physicists have resurrected relationalism in the form of the requirement that theories should be background-free. If that requirement is correct, then structures in true theories will not be mere backgrounds, but will be capable of being the recipients of effects. Add to that the action–reaction principle, then such structures, including spacetime, become potential causes also. In the light of the action–reaction principle it is the fact that in classical physics space is a mere background that prevents us from being able to regard it as having a causal role and so prevents us from seeing it as having a dispositional essence. Thus it is the requirement of background-freedom that makes room for dispositional essences for spatial (and likewise temporal) properties and relations. And that space is occupied by the relationship between spatiotemporal properties and mass in General Relativity.

[114] On the other hand, a convincing argument that triangularity does have a dispositional essence would provide strong indirect evidence that the fundamental structural properties have dispositional essences also.

8

THE ILLUSION OF NOMIC CONTINGENCY

Traditionally it has been held that the laws of nature are metaphysically contingent. As we have seen in Chapter 3, the dispositional essentialist view entails that laws are necessary at least in the weak sense that they hold in all possible worlds where the grounding universal exists. The word 'weak' here does not indicate any lesser *kind* of necessity. On the contrary, the necessity of natural law is metaphysical necessity and rules out any possibility of a world where things behave contrary to the laws as they are in the actual world. It is this prohibition that goes against the traditional view that laws are contingent. One supposed source of this view is the fact that our intuitions tell us that laws are contingent.

This conflict with the traditional contingency of laws has been held to be a disadvantage for dispositional essentialism, perhaps a decisive disadvantage.[115] I, however, regard it as a positive advantage. When we review the options, the metaphysical necessity of laws seems the only realistic option. The opposite extreme is the regularity theory of laws according to which there is no kind of necessity attached to laws.[116] As regards intuition, it would appear that the regularity theory fares no better than dispositional essentialism. For it appears intuitive, as revealed in what we say, that some kind of necessity is associated with laws. We say that nothing *can* travel faster than light, not merely that nothing does do so. If I push something and it accelerates in proportion to the force I exert, it is not merely that it did do so but that it *had* to do so. The modal character of laws is shown by the fact that they support counterfactuals. The regularity theory makes it a mystery how they do so. The regularity theory tells us that the laws of w supervene only on facts about w. But the counter-

[115] See, for example Carroll (1994: 24) and Schaffer (2005: 9-10). Schaffer also rejects necessitarianism on the grounds of failing to observe the relationship between possibility and propositions (a proposition is the set of worlds at which it is true) and between possibility and recombination. Necessitarians should simply reject recombination. Schaffer's view of propositions (cf. Lewis 1986*b*: 27-50) is a useful tool for certain purposes. But as a *theory* of propositions it is very poor. Schaffer's point is that it has the consequence that the negations of law propositions are contentless (they are all the empty set). Is that a problem for the view of laws or the view of propositions? The problem, as is recognized by many, including Lewis, is for possible worlds semantics, for the point holds for all necessary falsehoods, including the claims that there are maps that need five colours, or that water does not contain oxygen. Likewise all necessarily equivalent contingent propositions come out as the same proposition, despite intensional differences. Clearly we need a more fine-grained notion of proposition. Schaffer cannot legitimately use what is known to be a problematic aspect of possible worlds in criticizing necessitarianism.

[116] Of course we can construct a *pseudo*-kind of necessity, e.g. 'nomological necessity', where something is nomologically necessary if it is true in all possible worlds which have our laws of nature. See Section 3.1.2.

factuals true at w involve facts concerning possible worlds other than w.[117] By contrast, the role of laws in supporting counterfactuals is easily explicable according to dispositional essentialism, given the relationship between dispositions and counterfactuals presented in (CA). Not too much weight should be placed on such considerations. More decisive are the arguments we considered in Chapter 4 which revealed the inadequacies of the Humean supervenience thesis and the failure of regularities to have the explanatory power we accord to laws.

If we reject the idea that laws have no modal character, then we move to the Dretske, Tooley, and Armstrong view that they have some kind of intermediate necessity. Their necessity is less than metaphysical necessity. Nomic necessity is metaphysically contingent. Here again it is mysterious how this intermediate necessity can support counterfactuals and explain things. The predicament of intermediate necessity in this respect is not so obvious as it is in the case of regularities. It is nonetheless just as real. And as we saw on closer inspection it can be seen that this account of laws and properties cannot do without metaphysically necessary relations among universals. But if ultimately the explanatory power of intermediate necessity must draw upon metaphysical necessity, there seems to be no reason not to just leave intermediate necessity out of the picture altogether and to allow metaphysical necessity to do the work openly and everywhere.

Having recapitulated the reasons why metaphysical necessity provides a more promising explication of laws than its rivals, I will now address the traditional view that laws are contingent. It is usually assumed that the traditional view is the consequence of a strong intuition that laws are contingent. That is not obvious to me, since it might be that the tradition stems more from the older view that laws of nature are the decrees of God and that God could have decreed otherwise. It might be that intuition is informed more by tradition than the other way around. Nonetheless it is true that we seem to find it possible to imagine laws to be false and that this may also be a source of the intuition. If so then the position of those who reject the intuition is strong. Whereas the link between imaginability and possibility was once held, under the influence of empiricism, to be close, it is now widely held to be very remote. At this point it might be sufficient to point to the work of Kripke and others and leave matters at that. Nonetheless, I do think that the intuition that laws are contingent may be sufficiently resilient in many philosophers that further argument may be necessary. In this chapter I shall provide further specific reasons for relinquishing that intuition. The strategy is to look first at more general grounds for the intuition—(a) below. Then I present an argument that the intuition is unreliable with regard to certain laws of nature, (b), before looking at a specific case where the intuition looks to be at its strongest, (c). In outline:

(a) The intuition that laws are contingent has been related to:

[117] Lewis resolves this problem by smuggling the concept of law into the analysis of counterfactuals. But that no more allows laws to support counterfactuals than the definition in the preceding footnote allows cats to support feline necessity.

(i) The (apparent) fact that we can imagine the laws of nature to be otherwise. Response: insofar as it is true that we can imagine laws to be false, that imagining tells us nothing about the metaphysical possibility of what is imagined (*pace* the empiricist tradition).[118] (ii) The fact that laws are epistemically contingent and come to be known *a posteriori*. Response: it is easy to show that epistemic contingency and *a posteriori* knowledge are entirely consistent with the proposition in question being necessary. More interesting is the conclusion that the modal status of a proposition can itself be epistemically contingent. This is significant because it suggests a potentially wide gap or mismatch between the modal status of propositions and our epistemic access to them and to their modality. In which case we cannot draw any conclusions about the modal status of laws from the ways in which we come to know them.

(b) The pressure placed by (a), on the possible sources of the intuition that laws of nature are contingent, is general; (a) undermines the relationship between imagination or epistemology on the one hand and modality on the other. It is left open that there is some other reason why the intuition concerning laws is one we may rely upon. This section mounts a direct attack on that intuition. I will show that the intuition gets matters wrong in respect of laws that have a certain structure of supervenience on lower-level laws. One such law is that salt dissolves in water. On grounds fully independent of the dispositional essentialist and necessitarian view I am arguing for (i.e. on grounds the categoricalist should accept also) it will be shown that this and other such laws are necessary. Even if the basic laws are contingent, then some supervening laws are nonetheless necessary in a highly non-trivial way. Such laws *look* like any other law and appear just as contingent. If our intuition about the modal status of laws gets the modality of laws in this particular category wrong, we should not trust that intuition when applied to laws in general; it cannot give us a reason to deny the necessity of all laws.

(c) Having considered the two possible grounds of the contingency claim in (a) and having shown that our modal intuitions are unreliable in the case of laws, I then go on to ask where we can explain the illusion of contingency for necessary laws. Kripke provides a specific mechanism for explaining how it seems to us that we can imagine the falsity of an identity statement that is in fact true. I show how this mechanism can be employed to show how it appears that we can imagine counterex-

[118] Cf. 'To form a clear idea of anything is an undeniable argument for its possibility, and is alone a refutation of any pretended demonstration against it.' (Hume 1739-40/1978: book I, part III, section VI); and 'What is thinkable is possible too.' (Wittgenstein 1922/1961: §3.02).

amples to the laws of nature. However, I ask how Kripke's strategy can be simplified—so doing reveals the connection between the illusion of contingency and the fact of epistemic possibility.

(d) Finally I present a hypothesis as to why we should expect intuition to be reliable as regards judgments of possibility and necessity of laws.

8.1 The illusion of contingency of laws

8.1.1 *Imagining necessary falsehoods*

If imagining is the real source concerning our intuition of the contingency of natural law, then those who rely on this intuition should tell us more about what 'imagining' amounts to. For it is not at all clear why we cannot imagine necessary falsehoods to be true. Some laws are not basic but supervene on those that are. Sometimes A may supervene on B in a sufficiently complex way that it may not even be clear that A supervenes on B, let alone how. Hence it may be that the basic laws are necessary but the supervening laws, while also necessary, are not obviously necessary, nor even obviously true. Hence it may be possible with ease to imagine the supervening laws to be false. We know there is a proof of the four-colour theorem, but that does not make difficult to imagine, in some sense, finding a map that one could not colour with fewer than five colours. And one might think that this sense of 'imagine' is the one that is appropriate to imagining that a lump of salt placed in water does not dissolve or that a decrease in the volume of a gas is followed by a decrease in its pressure. It is to be admitted that this fact did not make us think that the four-colour theorem is contingent. That is because we start with an intuition that all mathematical propositions are necessarily true or necessarily false. We do not start with such an intuition regarding the laws of nature. And even if we recognize that some more basic laws of nature are necessary, it would not always be clear that the less basic law under consideration is supervenient on them.

To get clearer about the relationship between imagining and metaphysical possibility, I shall consider a pair of interpretations of 'imagine', suggested by Shoemaker, that might fit the case.[119] First, as in the preceding paragraph, we can give ourselves a picture of what it would be like to discover the relevant proposition to be false. We can picture to ourselves a white crystalline substance being placed in water and its failing to dissolve; we say to ourselves 'that is salt'. We thus have a picture of salt not dissolving. The pictorial element of this imagining is just the same for a picture of barium sulphate not dissolving. The only difference is that we think of the white crystalline substance under the name 'salt'.

The pictorial element on its own certainly depicts a possibility—a white crystalline substance not dissolving. Does the addition of the naming of the white substance really amount to imagining that salt fails to dissolve? In the second sense of 'imagine' it does not, for at best we are imagining *naming* the substance 'salt', and that doesn't make it a case of imagining salt. In the stronger sense of 'imagine', to imagine a putative possible world requires a detailed representation of its relevant

[119] Shoemaker (1980: 231). Shoemaker talks in terms of 'conceiving' where I have used 'imagining'.

parts. The picture plus labelling does not achieve that. Peter van Inwagen articulates the difference thus:

> Can we imagine a world in which there is transparent iron? Not unless our imaginings take place at a level of structural detail comparable to that of the imaginings of condensed-matter physicists who are trying to explain, say, the phenomenon of superconductivity. If we simply imagine a Nobel Prize acceptance speech in which the new Nobel laureate thanks those who supported him in his long and discouraging quest for transparent iron and displays to a cheering crowd something that looks (in our imaginations) like a chunk of glass, we shall indeed have imagined a world, but it will not be a world in which there is transparent iron.[120]

Thus those who would employ a link between imagining and possibility face a dilemma. On the one hand, if one uses the strict conception of imagining, then there is at least a *prima facie* link. But in such cases really imagining some state of affairs requires a detailed consideration of the subject matter that philosophers, as Seddon (1972) complains, almost never give. Furthermore it is difficult to see how such imagining can take place without a fair degree of knowledge already of what is possible. For strict imagining requires employment of knowledge of the *nature*[121] of the relevant things and that in turn will be knowledge of essences and so knowledge of what is and what is not possible. That is particularly problematic for the present case of laws. For the very issue at dispute is the nature of laws and whether that nature renders them necessary or contingent. On the strict conception of imagining, one's imagination is unable to rule out necessary laws precisely because what one holds to be imaginable is answerable to what one believes about the nature of laws rather than the other way around.

The second horn of the dilemma catches the loose sense of imagining, according to which I do imagine salt dissolving when I have a mental picture of the dissolving white substance which I have mentally labelled 'salt'. For on this loose conception one is not entitled to draw any metaphysical conclusions from such imaginings. For example, Lois Lane could imagine a scene where Superman meets Clark Kent: she has a picture of two men, one of whom she thinks of as 'Superman', the other as 'Clark Kent'. The possibility of such a picture-with-naming in no way shows that 'Clark Kent is Superman' is contingent. In conclusion, the empiricist wants a straightforward, empirical, psychological test of possibility. But in order not to get the wrong result from supposed cases of imagining that one might find a map that needed five colours or that Superman is not Clark Kent, one must distinguish 'really' imagining (i.e. strict imagining) from merely thinking that one imagines in such a way that in

[120] Van Inwagen (1998: 79). George Seddon (1972) anticipates van Inwagen in this, and provides some of the detailed scientific arguments required to deny that there is a possible bar of iron that floats in water or a possible carnivorous rabbit on Mars. Both Seddon and van Inwagen reject any such thing as logical possibility and regard as the fundamental possibility that which I have called metaphysical possibility.

[121] Cf. Blanshard's (1962) account of conception which also requires a complete understanding of its object and which equates to strict imagining; this he contrasts with his account of imagination (our loose imagining), which is not even necessary for possibility.

consequence the test is no longer straightforward and it is at least as difficult to decide whether S really imagines *p* as to decide whether, on independent grounds, *p* is possible.

8.1.1.1 *Hume's Dictum* The inference from conceivability or imaginability to possibility is closely related to Hume's Dictum that there are no necessary connections between wholly distinct existences.[122] Hume's Dictum does contradict the principal contentions of this book. A disposition and it manifestation, or a cause and its effect, or the antecedent of a law and its consequent all seem to be cases where we will often find distinct existences. But dispositional essentialism and its consequent nomic necessitarianism declare that the members of these pairs are necessarily connected.

The appropriate strategy for responding to a criticism based on Hume's Dictum is the same as that for the conceivability–possibility criticism. Indeed, since Hume's own argument for the Dictum is an application of the conceivability–possibility inference, the previous argument against the latter will undermine Hume's motivation for the former. There may nonetheless be yet other motivations for the Dictum. The problem with the Dictum, as with the conceivability–possibility inference, is that insofar as it does conflict with dispositional essentialism, it far from obviously true.[123] And insofar as it is clearly true, it is more than questionable whether it can be used to criticize dispositional essentialism. For example, there are necessary connections between potencies in the same network. But they do not thereby fall foul of the Dictum, since the network view of potencies claims that the identity of each potency supervenes on the structure of the whole network, which implies that they are not distinct existences—if we take distinct existences to be entities that may exist independently of one another (which renders the Dictum trivial). On the other hand, if we understand distinct existence mereologically—distinct existences have no common parts—then fundamental potencies are distinct existences, and the Dictum is not trivial. But why should we suppose that it is obvious that distinct existences in this sense should not be necessarily, even essentially, related?[124] Understood thus or in other ways that conflict with dispositional essentialism, the Dictum is a substantive metaphysical thesis that stands in need of substantive argument. But I do not know of any such argument that is as compelling as the arguments against categoricalism and in favour of dispositional essentialism.

[122] 'There is no object, which implies the existence of any other if we consider these objects in themselves.' (Hume 1739-40/1978: book I, part III, section VI).

[123] As Jessica Wilson (2006) points out, in order for the Dictum to conflict with the necessary connection between cause and effect and between disposition and manifestation, the Dictum must be formulated in such a way that it states that given an actual world pair of distinct cause and effect (or disposition–and–stimulus and manifestation) there are possible worlds where the cause exists, plus background conditions (i.e. the absence of finks and antidotes), but without the effect. Wilson continues with extensive criticism of the basis for Hume's Dictum.

[124] Numbers are distinct existences on the mereological conception (arguably this is true even if one takes a set-theoretic account of numbers). But they are essentially related to one another. (It is true that being necessary existents they are necessarily related to everything, but for that reason Hume's Dictum is best phrased in terms of essential rather than necessary relatedness.)

8.1.2 *Epistemic possibility*

It may be natural to suppose that the laws of nature are contingent on the grounds that they are known *a posteriori*, that they are epistemically contingent. But it is clear that there is no valid inference of this sort. In the following '$\Box p$' and '$\Diamond p$' represent metaphysical necessity and contingency, while 'Lp' and 'Mp' represent epistemic necessity and possibility.

(i) Laws are metaphysically necessary but not epistemically necessary: $\Box p$ but $\neg$Lp (i.e. $\Box p \wedge$M$\neg p$). There are of course many other such cases. Identities such as 'George Orwell is Eric Blair' provide obvious instances of necessary truths that are not epistemically necessary (their negations are epistemically possible). Similarly, <it is *a posteriori* whether p> is consistent with <$\Box p$>). To say that it is *a posteriori* whether p is equivalent to saying that it is not *a priori* that p and not *a priori* that $\neg p$. This in turn is equivalent to <M$\neg p \wedge$Mp> which is naturally expressed as saying that p is epistemically contingent (by analogy with metaphysical contingency: $\Diamond \neg p \wedge \Diamond p$). The same identities are such that it is *a posteriori* whether they hold. So we have <(M$\neg p \wedge$Mp)$\wedge \Box p$>; and so <(M$\neg p \wedge$Mp)$\wedge(\Box p \vee \Box \neg p)$>, which is <(M$\neg p \wedge$M$p$)$\wedge \neg(\Diamond \neg p \wedge \Diamond p)$>. Thus such identities are instances of epistemic contingency plus the denial of metaphysical contingency. Other cases illustrating this include undecidable propositions of arithmetic: any such proposition is necessarily true or necessarily false, but both truth and falsehood are epistemically possible.

(ii) It might be objected to the use of arithmetical propositions and identities that in such cases the fact that such propositions are metaphysically non-contingent is known to us, whereas in the case of laws it is not. Similarly, for such propositions we know ($p \rightarrow \Box p$)—even if ignorant that Blair is Orwell, I nonetheless know, thanks to Kripke, that if Blair is Orwell, then necessarily Blair is Orwell. But we do not know that if some law is true, it is necessarily true. Of course I might hope that the arguments of this book together with those of other dispositional essentialists will change this, as Kripke's arguments did for identities. Nonetheless there are other cases where it is true that $\Box p \vee \Box \neg p$ but it is not known that $\Box p \vee \Box \neg p$, and indeed, more generally where it is epistemically contingent that $\Box p \vee \Box \neg p$. Similarly there are cases where it is true that $\Box p$ but I do not know (and it epistemically contingent) that $p \rightarrow \Box p$. Taking the latter first. Let q be a mathematical proposition and r some clearly contingent proposition. The proposition $q \vee r$ is necessary if q is true and is contingent if q is false. If we do not know the truth value of q we do not know the modal status of $q \vee r$. Let us say that q is true but not known to be true, so it is true that $\Box(q \vee r)$. Do we know that $(q \vee r) \rightarrow \Box(q \vee r)$? No, because the truth of the antecedent is consistent with the falsity of q (because r may be true) and so is consistent with the falsity of $\Box(q \vee r)$. In such a case, where q is true it is also true that $\Box(q \vee r) \vee \Box \neg(q \vee r)$ but we do not know this. Since we do not know that q is true, we do not know that $(q \vee r)$ is not contingent, viz. we do not know $(\Box(q \vee r) \vee \Box \neg(q \vee r))$. Furthermore, if q is undecidable, q cannot come to be known *a priori*, and so it is epistemically contingent whether $\Box(q \vee r) \vee \Box \neg(q \vee r)$.

(iii) A proposition may be necessary but that it is true can be known only *a posteriori*. The (necessary) truth of an identity claim is an example of such. But as above, one knows *a priori* that the proposition is not contingent, even if one does not know

whether it is true or false. However, in some cases , whether a proposition is contingent or non-contingent may also be knowable only *a posteriori*. For example 'Tony Blair was born in the same year as Jeb Bush' is contingent whereas 'Eric Blair was born in the same year as George Orwell' is necessary. So whether 'X was born in the same year as Y' is necessary or contingent depending on whether X=Y. Consequently, since it may be knowable only *a posteriori* whether X=Y, it is knowable only *a posteriori* whether 'X was born in the same year as Y' is necessary or contingent. Note, in addition, that if it is true that X=Y but we are not in a position to know that fact, then, concerning a proposition ('X was born in the same year as Y') that is in fact necessary, it is epistemically possible that we will discover *a posteriori* that it is contingent.

In conclusion, it should be fairly obvious that epistemic possibility is a poor basis for an inference of metaphysical possibility, and likewise that epistemic contingency is a poor reason to infer metaphysical contingency. Less readily noticed is the fact that we are not always in a position to know the modal status of a proposition (that is, whether it is contingent or non-contingent). For even though a proposition is epistemically contingent we are sometimes in a position to know that it is either necessarily true or necessarily false. But that is not always the case. Furthermore, in some cases, the status of a proposition as necessary or contingent can be known only *a posteriori*. Consequently we have no reason to believe that if laws are necessary, that fact should be obvious to us; similarly, the fact of their appearing to be contingent, provides only the weakest reason for supposing that they are.

8.2 The unreliability of our intuitions concerning the contingency of laws of nature

In the preceding section I have argued that we lack good reasons for thinking that our intuitions as regards modality are reliable, insofar as they stem from either imagination or epistemic possibility. More generally there is no reason why our intuitions concerning modal status should be reliable in all cases. If necessity were no more than analyticity then we could read off the modal status of a proposition from its cognitive content. Analytic truth and analytic falsehood are knowable by inspection. Hence necessary truth and necessary falsehood would be knowable by inspection, and by elimination contingency would be also. But of course necessity is not analyticity. And as we have seen it is provable that one cannot always infer a proposition's modal status from its content. In general it is, I think, the exception rather than the rule that the content of a proposition tells us its modal status. For example, propositions of the form 'R(X,Y)', where 'R' denotes an equivalence relation (e.g.'R' = 'has the same birthday as') and 'X' and 'Y' are proper names, may be contingent or may be necessary, depending on whether X=Y. Since one cannot infer a proposition's modal status from its content, the burden of proof is on those who reject the contingency of laws to tell us why we should rely upon their intuitions.

The above considerations are nonetheless consistent with the thought that our modal intuitions are reliable in the specific case of the laws of nature, although they do put pressure on such a supposition and place the onus on those who do suppose it to explain why it should be so. In this section I shall sketch an argument to show that

our intuitions concerning the contingency of laws of nature are not indeed reliable: a law of nature may be necessary yet appear to be contingent. A certain higher-level (non-fundamental) law is necessary even if the fundamental laws are themselves contingent. But the higher-level law appears to be contingent. Hence our intuitions concerning contingency are unreliable in this area. The idea that a non-fundamental law may be necessary while being a consequence of fundamental laws that are contingent, may strike some as strange. But of course all necessary truths are entailed by any contingent truth. Furthermore, non-trivial necessary truths are *deducible* from premises that are all contingent. For example, from $\forall x$(x is comprised of water $\rightarrow$ x is comprised of the main constituent of living things on Earth) and $\forall x$(x is comprised of the main constituent of living things on Earth $\rightarrow$ x is comprised of H_2O) we may infer $\forall x$(x is comprised of water $\rightarrow$ x is comprised of H_2O).

For the purposes of the argument of this section, I shall assume that the fundamental laws are contingent. The purpose of this argument is *not* to show in general that we should think that the laws of nature are necessary. (The argument for that is to be found in Chapter 3.) Rather it is to show that some laws must be held to be necessary whether one is a categoricalist or a dispositional essentialist. Since the categoricalist ought to accept this argument (it makes no dispositional essentialist assumptions), the categoricalist must concede that some laws are necessary even though they look contingent. To concede that is to concede that the categoricalist's intuition concerning the contingency of all laws is unreliable. In which case that intuition cannot have any force against the dispositional essentialist claim that *all* laws are necessary.

The structure that makes a higher-level law necessary even if it supervenes on contingent fundamental laws is this. Higher-level laws relating substances supervene on lower-level laws in two respects. First, and most obviously, the relationship in question depends on the lower-level laws. Secondly, the substances themselves exist in virtue of laws. The structure of supervenience becomes complicated if the same laws are involved in both aspects: the existence of the relationship and the existence of the relata. Let it be (a) that the law L (by definition) relates two substances S and W, by the relationship D. Let it be (b) that D supervenes on a lower-level law C in such a way that C is necessarily sufficient for D. And (c) let the existence of S (and/or W) depend on lower-level laws F in such a way that if any of F are false, then necessarily S does not exist. Now let it be the case (d) that the laws F include C. From (a) we have $\Box(\neg L \rightarrow \neg D)$. From (b) we have $\Box(\neg D \rightarrow \neg C)$. And so we have (e) $\Box(\neg L \rightarrow \neg C)$. From (c) and (d) we have (f) $\Box(\neg C \rightarrow \neg$(S exists)). From (e) and (f) we have (g) $\Box(\neg L \rightarrow \neg$(S exists)).

The conclusion is that, necessarily, if the law is false then one of the substances related in the law does not exist. Or, contraposing, necessarily, if the substances related in the law exist, then the law is true. So what we do not have is a possible world where the substances exist but are not related in the way that L says they are. I.e. L is, in the relevant sense, necessary. (By 'relevant sense' I mean the sense in which Kripkean identity is necessary. A and B are necessarily identical in that A=B in all worlds

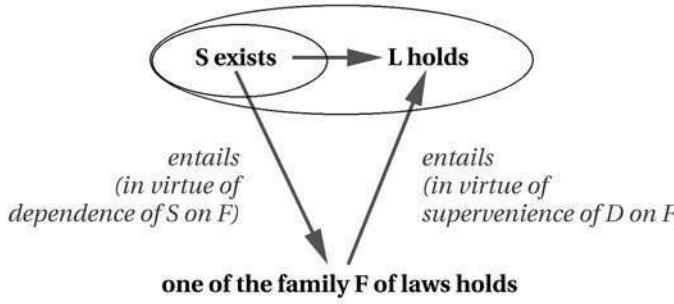

FIG. 8.1. L is a law that ascribes D to substance S. D supervenes on a lower level law, C, a member of the family of laws F, all of which are entailed by the existence of S.

where A and B exist. Similarly, L is necessary in that L is true in all worlds in which the substances it relates exist.)

This structure is exhibited in the case of the law that salt dissolves in water. In all possible worlds where salt and water exist, the truth of Coulomb's law of electrostatic attraction is sufficient to make salt dissolve in water. Given the constitution of salt and water (which are necessary by Kripke's arguments), the forces of electrostatic attraction governed by Coulomb's law are sufficient to ensure that when salt is placed in water, the sodium and chlorine ions in the salt will go into solution. So if our law is to be false in some possible world, Coulomb's law had better be false in that world. But now we notice that the existence of salt itself depends upon Coulomb's law. Salt is an ionic crystal and the sodium and chlorine ions in the salt are held together by electrostatic attraction. If Coulomb's law were false, salt could not exist. So we cannot have a world where it is true both that salt exists (which would require Coulomb's law to be true) and that salt fails to dissolve in water (which would require Coulomb's law to be false.)[125]

So contrary to appearances, it is necessary that salt dissolves in water—*even if Coulomb's law is itself contingent*. The argument for this necessity is entirely independent of the arguments concerning dispositionalism versus categoricalism, and so is not question-begging with regard to that discussion. Of course, if the fundamental laws are themselves necessary (for dispositionalist reasons), then this law will be necessary twice over.[126] The law is necessary in the current manner because of the subtleties of the way in which it supervenes on the lower-level laws. Those subtleties tend to escape the attention of even those among us who know what is going on beneath the surface (one rarely engages in physical chemistry and modal metaphysics at the same time). And they are of course hidden to those who don't know the chem-

[125] This argument is a condensed sketch of more detailed discussions in Bird 2001, 2002, and 2005*d*.

[126] And there is nothing odd in that. <2+2=4 ∨ Eric Blair = George Orwell> is necessary twice over.

istry. For this reason, this law is clearly epistemically contingent and it is thus not surprising that we should think it is metaphysically contingent too.

The lesson that the dispositionalist draws from this is not that we have another argument for the necessity of laws of nature. This route will capture only some of the laws and not the fundamental ones. Rather, the lesson is that our intuitions concerning the contingency of laws are not to be trusted. The force of intuition is a very weak argument against the dispositionalist claim that all the laws of nature are necessary.

8.3 Kripke's strategy and the illusion of contingency

According to the dispositional essentialist, the apparent contingency of the laws of nature is an illusion. If so, whence does it arise? The illusion is often supposed to arise from epistemic contingency. But a direct inference from epistemic contingency to metaphysical contingency is too poor to be, as it stands, a convincing explanation of apparent metaphysical contingency.[127] The illusion created by imagination is a more likely source, but more needs to be said. In this section I show how the illusion does arise, extending Kripke's strategy to the case of laws.[128] I then show how that strategy may be simplified and how it does depend on epistemic contingency, but in a manner less direct than a matter of simple inference.

8.3.1 *Kripke's strategy for identity generalized*

How does the illusion arise in the case of the necessary identity of Hesperus and Phosphorus or of water and H_2O? We may imagine an individual S who is ignorant of these identities. In each case S can imagine a pair of possible worlds, one where S's use of referring terms is such that they refer to the same entity, and one where they do not. But these worlds do not differ from one another nor from the actual world in any respect of which S is aware. So S imagines that in w_A S uses 'Hesperus' and 'Phosphorus' to refer what is one and the same planet, while S also imagines that in w_B S uses 'Hesperus' and 'Phosphorus' to refer to two different planets. Since S does not know whether Hesperus is Phosphorus, S does not know which of w_A or w_B is the actual world. Similarly in w_{H_2O} S uses 'water' to refer to a substance which is H_2O, in w_{XYZ} S uses 'water' to refer to a substance which is XYZ. Since S does not know whether water is H_2O or not, S does not know whether S is in w_{H_2O} as opposed to w_{XYZ} or some other such world. The thought is that it is this ignorance that leads to the illusion of metaphysical contingency in the case of identity propositions. As Kripke (1980: 103-4) remarks (with my emphasis): '... it's true that given the evidence someone has antecedent to his empirical investigation, he can be placed in a sense in exactly the same situation, that is a qualitatively identical epistemic situation, and call two heavenly bodies "Hesperus" and "Phosphorus", without their being identical.

[127] Ellis (2001: 231-4) rightly argues against the imaginability test for possibility, but too quickly attributes its error to a confusion of epistemic and metaphysical possibility.

[128] Schaffer (2005: 11) alleges that this cannot be done. See Wilson (2006) for a response to Schaffer. Schaffer takes it that Kripke's arguments for necessity depend on the proof of the necessity of identity. But, as Wilson points out, they do not and in any case they show the necessity of propositions other than identities, e.g. propositions concerning origin and constitution.

So in *that sense* we can say that it *might* have turned out either way.' The sense of 'might' is not metaphysical; it is clearly a kind of epistemic 'might', but it is this that gives the illusion of metaphysical contingency.

The proposition that S does not know that S is in a world where 'A' and 'B' are co-referring is entailed by the proposition that it is epistemically contingent for S that A=B. (If it is epistemically contingent for S that A=B, then it is not deducible from what S knows that A=B; therefore S does not know that A=B, therefore S does not know that 'A' and 'B' are co-referring; therefore S does not know that S is in a world where 'A' and 'B' are co-referring.) Thus for identities epistemic contingency entails the situation that permits the illusion of metaphysical contingency. My hypothesis is that, *ceteris paribus*, epistemic contingency will give rise to the illusion of metaphysical contingency for other kinds of proposition too (e.g. law statements). I add the *ceteris paribus* clause because we might have independent reason for thinking that the proposition in question belongs to a kind whose members are all either necessarily true or necessarily false. Mathematical propositions are the obvious case of this. For philosophers convinced by Kripke, identity propositions may have lost their appearance of contingency; perhaps the same will happen in due course to propositions concerning laws. My suggestion is that these other considerations being absent, epistemically contingent propositions will appear to be metaphysically contingent.

The general strategy for deriving the illusion of metaphysical contingency from epistemic contingency is this. Let P be a necessary truth but epistemically contingent for some S. Identify some term 't' in P, so that P can be re-written P(t). S does not know which of P(t) or ¬P(t) is true. Consider some entity t^* which is defined to have the following characteristic: $\forall\xi$((S knows $\xi(t) \rightarrow \xi(t^*)$) & ¬P($t^*$)) (i.e. everything that S knows to be true of t is also true of t^*, and it is false that P(t^*). Since P(t) is necessary, then clearly $t \neq t^*$, but S does not know this. Let w_{t*} be a world which possesses t^*. As far as S can tell not only is w_{t*} entirely possible but w_{t*} might be the actual world. The 'might' here is of course epistemic—S does not know whether w_{t*} is the actual world. Just as in Kripke's case, there is a pair of worlds w_t (the actual world containing t) and w_{t*} such that the subject S, not knowing which is actual, can conceive of each being the actual world consistently with all S's evidence (all S knows).[129]

For S, the illusion of contingency for P(t) is created because S does not know whether S is in a world where P(t) or one where ¬P(t^*). Now it may turn out that thanks to *a posteriori* inquiry we have discovered that P(t), so we know we are not in a world where ¬P(t^*). For us the illusion of contingency arises because we can imagine ourselves being in S's shoes and can conceive the possibility of the history of science developing with different *a posteriori* discoveries to a position where it was known that ¬P(t^*). Since S can be imagined to be a person with any level of empirical knowledge short of knowledge that P(t), we can consider an S who has only *a priori* knowledge. Thus any proposition that is necessarily true can appear to be contingent, so long as it is not known that it is non-contingent.

[129] 'Consistently' here refers to deductive consistency, not modal consistency.

8.3.2 *The strategy applied to laws of nature*

'P(t)' might be the statement of a law of nature. We can imagine that the second law of thermodynamics is false, even if that law is not contingent. The nature of heat was a matter of dispute in the eighteenth and nineteenth centuries. The kinetic theory always had its defenders; but it was, as is well known, superseded for a period by the caloric theory which took heat to be a substance. Even within the caloric camp there were differences. For example, although history records the view of caloric as a subtle and imponderable fluid, it was by no means universally agreed that caloric should be perfectly massless. Indeed one strong reason Count Rumford had for doubting the caloric theory was the fact that he could not find any loss or gain of weight of a substance on cooling or heating. Even Joseph Black, a cautious supporter of the caloric theory, acknowledged that this was a serious objection to the theory. A massless substance (indeed, an element according to Lavoisier) was anomalous. Consequently it may have been plausible to suppose that caloric had very little mass, rather than none, especially if one was ignorant of Rumford's experiments (which were largely ignored) or lived before them (they were carried out in the 1790s). But if caloric has some mass it would be implausible to suppose that it is *perfectly* subtle. Indeed one could account for differences in specific heats by reference to different degrees of permeability to caloric. Consider then the following experimental arrangement. Two volumes of gases of equal temperature are separated by a membrane impermeable to those gases. But the membrane is partially permeable to caloric, in that caloric can pass through it in one direction but not in the other. Consequently caloric will accumulate on one side of the membrane. Since caloric is supposed to be heat, this means that the gas on one side will heat up and the gas on the other will cool down, from an initial arrangement of equal temperature. Not only is this arrangement deductively consistent with what was believed by many about caloric in the 1780s, it would not have been especially implausible to them either. The corpuscularian tradition held that the smallest particles of matter had particular shapes and that these shapes helped explain their behaviour. If we suppose that particles of caloric have some small mass and so volume we would be led to suppose they have a size and shape that explain their behaviour.

The Kripkean strategy applies here thus. Let w_{kin} be the actual world, where the phenomena of heat (in gases) are explained by the kinetic theory; let w_{cal} be a world as described in the last paragraph, where caloric has the superficial effects that heat has in the actual world. In w_{cal} the term 'heat' refers to caloric. To avoid ambiguity we will use the term 'heat*'. We can form the following statements about quantities in the actual world: 'Φ(heat)' which is 'heat always flows from hotter to cooler' and 'Ψ(S)' which is 'δS≥0' (where δS=δQ/T and Q symbolizes the quantity of heat). 'Φ(heat)' and 'Ψ(S)' are true, and can be regarded as alternative statements of the second law of thermodynamics. In w_{cal} the parallel statements 'Φ(heat*)' and 'δS*≥0' (where δS*=δQ*/T and Q* symbolizes the quantity of heat*, i.e. caloric) are false, since we have some cases where heat flows from cooler to hotter. A inquirer of the 1780s is not in a position to know whether he is in w_{kin} or w_{cal}, whether he is in a world in which the second law of thermodynamics holds or one in which the analogous

second law of thermo*dynamics is false. On the assumption that this indiviudal does not presume law statements to be non-contingent, we can generate an illusion of contingency for him. As explained, the same illusion holds for (some of) us who can imagine ourselves in his position.

8.3.3 *Modifying Kripke's strategy*

Thus the Kripkean strategy applies equally well to laws as it does to identities. Even so, there are questions to be asked about the strategy, in particular whether it is strictly required. One clear problem with it is that it requires the alternative world under consideration to be genuinely possible: it is supposed to be possible that there is a world where a substance is water-like but has some formula other than H_2O, it is supposed to be possible that the surface phenomena explained by heat could have been explained by caloric. But it is far from obvious that these are genuine possibilities. One complaint made against Putnam's (1975) famous Twin-Earth thought experiments is that there is no possible XYZ that has anything like the superficial properties of water but which is not H_2O. We know enough about molecular structure to be able to prove that within actual world chemistry and anything like it there is nothing other than H_2O that will do the job. Thus a world with XYZ performing the function of water would have to be radically different from the actual world as regards its laws. But since we are seeking to explain how laws can be appear to be contingent despite being necessary, we cannot presume as part of the explanation that the laws could be different. In any case, can we be confident that, in a world where the laws of chemistry are indeed different, Twin-Oscar could even exist let alone see his world to be a way that is similar to the way Oscar on Earth sees the actual world? If we start changing the laws of chemistry (and hence of physics—since we can only change chemistry by changing the underlying physics—and of biology—since any radical change to chemistry will change the biology that depends upon it) it is implausible that we could leave the macro-level appearances unchanged.

Similarly, it is implausible that a world with caloric could be superficially similar to ours. First, there seems to be no room in physics for a new kind of matter that is more subtle than ordinary matter but which is attracted to it and usually exists within its interstices. So such a world would have to have a fundamentally different physics. But if we change physics in order to permit caloric, can we be sure we still have the rest of matter? Secondly, if we do have caloric plus ordinary matter we have a problem with the reference of 'heat'. For if we have ordinary matter we also have molecular motion and vibration and all the usual, actual sources of heat. So we have the phenomena of heat caused by two distinct mechanisms. In which case 'heat' won't refer uniquely to caloric. So to have a world in which 'heat' does refer to caloric (but not to anything else) we cannot have ordinary matter behaving as it ordinarily does. If so, how can there be observers noting heat phenomena and language users referring to those phenomena and their causes?

So it seems implausible that there are genuine possible worlds of the kind that the Kripke strategy requires. At the very least, we do not *know* that there are such worlds. To see how to respond to this problem let us return to H_2O and XYZ. Would the im-

possibility of Twin-Earth undermine Putnam's argument, as some philosophers have argued (Kuhn (1990) for example)? No, it would not. What Putnam's argument seeks to show is that 'water' is, in Kripke's terms, a rigid designator. That is, we, as users of the term 'water' do not regard its correct use as depending solely on the mental states of the user, but also on external features of the world; in particular we users require that instances of the term's extension should be of the same kind as the standard samples of the kind that were used to fix the reference of the term in the first place. To show this, the datum Putnam needs is not the possibility of Twin-Earth; rather the data are *our* responses as competent languages users regarding the correct use of the term. Our intuitions about whether Twin-Oscar is referring to H_2O or to XYZ are what are required to show that 'water' is a rigid designator. To elicit those intuitions it is required simply that we can conceive of Twin-Earth, not that it should be metaphysically possible.[130]

If conceivability is all that is required for Putnam's argument, it ought to be all that is required for Kripke's strategy too. After all, we are trying to explain a psychological state of the subject—believing some proposition to be contingent—by reference to what he or she conceives. Such an explanation could not depend upon whether the conceived world, in fact and unknown to the subject, is metaphysically possible.

We may ask what conceivability amounts to here. Let us consider worlds as sets of propositions. A metaphysically possible world will be a world where the propositions in the set are collectively metaphysically compossible. Let P be a (metaphysically) necessary truth. Let w_a be the actual world. Let S not know the truth value of P and believe falsely that P is contingent. Kripke's strategy for the illusion of contingency for P requires us to find a world w_b that is epistemically like w_a and where some analogue of ¬P is true, that is a proposition expressed in w_b by the sentence '¬Π' such that in the actual world the sentence '¬Π' expresses ¬P. Of course in w_b '¬Π' does not express ¬P, since the terms in 'Π' have different referents in the different worlds. We may now ask whether S should be aware that 'Π' as used in w_a expresses one proposition whereas 'Π' as used in w_b expresses a different proposition, in virtue of the relevant terms referring in the different worlds to different entities.

I argue that S should not ordinarily be aware of such a difference, for the reason that such awareness would be tantamount to awareness of the necessity of P, and so would be a poor explanation of the apparent contingency of P. To see why, let 'P' be 'water is H_2O'. Our question is this then: is S aware that 'water is H_2O' used in w_{H_2O} expresses a different proposition from 'water is H_2O' used in w_{XYZ} in virtue of 'water' referring to H_2O in w_{H_2O} and referring to XYZ in w_{XYZ}? Let us say that S does know this. Then S can immediately infer that if in the actual world 'water' refers to H_2O and not to XYZ, then the proposition expressed by the actual world sentence 'water is H_2O' is necessarily true, and similarly, if in the actual world 'water' refers to XYZ and not to H_2O, then the proposition expressed by the actual world sentence 'water is H_2O' is necessarily false. As it stands, insofar as Kripke's explanation of the illusion of contingency requires the subject to appreciate that the propositions expressed by

[130] For further discussion of this point in reference to Kuhn and others, see Bird (2004).

	w_{H_2O}		w_{INT}		w_{XYZ}
S's mental states in w_i	S has water thoughts	=	S has water thoughts		S has twater thoughts
physical states in w_i	H_2O plays the water role		XYZ plays the water role	=	XYZ plays the water role

TABLE 8.1. Neither w_{INT} nor w_{XYZ} are genuinely possible worlds. The illusion of contingency of 'water is H_2O' is best explained by a subject's being able to conceive of w_{H_2O} and w_{INT} equally, without knowing which is actual.

the same sentence in the two worlds are different, then that explanation is very close to requiring that the subject should realize that 'water is H_2O' is not contingent but either necessarily true or necessarily false. In which case it seems to be a poor explanation of the illusion of contingency.

Therefore Kripke's explanation ought to have it that the subject's conception of what her sentences mean should not differ between her representation of the two worlds she is thinking about. Let us call this the Similarity of the Representation of Meaning requirement. This requirement allows us to modify Kripke's strategy in a way that both simplifies it and makes it a better explanation of the contingency illusion. Consider a world (set of propositions) w_{INT} that is a cross between w_{H_2O} and w_{XYZ} in that it has the following features: (i) w_{INT} is *physically* just like w_{XYZ}, at least as far as matter beyond S's head are concerned. Thus propositions in w_{INT} giving descriptions of the physical characteristics of things assert that rivers contain XYZ. (ii) w_{INT} is *mentally* just like w_{H_2O}. For simplicity I shall assume that all S's beliefs amount to knowledge, and that we can ignore other persons. So S's states of knowledge in w_{INT} are identical to those in w_{H_2O}. World w_{INT} is not metaphysically possible. Since S in w_{H_2O} knows that there is water in rivers then S in w_{INT} knows exactly the same proposition (where 'water' continues to mean what it means in the actual world, i.e. with H_2O as its extension). Were w_{INT} a genuinely possible world, then, since knowledge is factive, there would have to be water (H_2O) in the rivers of w_{INT}. But since w_{INT} is physically just like w_{XYZ}, there is no water in its rivers, just XYZ.

S's (actual) representation of w_{XYZ} is the same as S's representation of w_{INT}. The difference between w_{XYZ} and w_{INT} lies only in the propositions ascribing mental states to S. In w_{XYZ} S's mental states are 'twater thoughts' (ones which refer to XYZ), whereas in w_{INT} the mental states are as in w_{H_2O} (they are ordinary water thoughts). But as we saw in the paragraph before last, according to the Similarity of the Representation of Meaning requirement, S's representations of S's mental states in w_{H_2O} ought not to differ from S's representations of S's mental states in w_{XYZ} (or else we

have a poor explanation of the contingency illusion). Hence S's representations of S's mental states in w_{INT} are also the same. Consequently there is no difference between S's representations of w_{XYZ} and of w_{INT}.

So whatever is explained by S's thinking about w_{XYZ} is equally well explained by S's thinking about w_{INT}. We can therefore explain the illusion of contingency at least as well by saying that it arises from the fact that S can coherently represent a world, w_{INT}, where (a) S's thoughts, beliefs, and states of knowledge are exactly the thoughts, beliefs, and states of knowledge that S has in the actual world, and (b) various actually false propositions that are epistemically contingent for S (such as: the water role is played by XYZ) are true. The fact that w_{INT} is not metaphysically possible is not relevant.

Here 'coherent representation' should be taken to mean a representation from which no absurdity is deducible.[131] The world w_{INT} consists both of propositions concerning the physical constitution of things and of propositions concerning S's knowledge and other mental states. Although these propositions cannot all be true together, no absurdity is deducible from S's representations of those propositions.

Our explanation of the illusion of contingency is now that S can coherently represent both $w_{\mathrm{H_2O}}$ and w_{INT} without knowing which is the actual world. For that to be the case S should not be able to deduce the proposition that water is H_2O from what S knows. If S could, S would know that $w_{\mathrm{H_2O}}$ is actual. To say that it is not the case that P is deducible from what S knows, is to say that $\neg$P is epistemically possible. So the coherent representation of w_{INT} requires at least the epistemic possibility that water is not H_2O (and related propositions).

Furthermore, S should not be able to deduce from S's representation of S's own mental states that water is H_2O. If S could, S could look at S's representation of w_{INT} and deduce from S's mental states there that water is H_2O, which would contradict the representation of w_{INT} that the water role is played by XYZ. So a contradiction would be deducible from S's representation of w_{INT}. This is clearly a stronger requirement than that of the previous paragraph. The latter requirement was: $\Sigma \nvdash$ P (where Σ is the conjunction of all propositions known by S, and P is the proposition that water is H_2O). However, the requirement of this paragraph is: $K\Sigma \nvdash$ P (where 'K ...' is 'S knows ...').

For arbitrary Σ, $<K\Sigma \nvdash P>$ is a stronger condition than $<\Sigma \nvdash P>$; if Σ contains only mathematical propositions, the fact of S's existence may be deduced from $K\Sigma$, but not from Σ. But in this case Σ contains all the propositions that S knows. Let us imagine that the K–K principle holds, i.e. $Kq \rightarrow KKq$. Take any r known by S, then S knows that S knows that r. In which case Kr is itself a component of Σ. So given K–K, if $<\Sigma \nvdash P>$ holds then so does $<K\Sigma \nvdash P>$. However, the K–K principle is false. Thus a case would arise where w_{INT} would not be coherently representable despite the epistemic con-

[131] This is a fairly strict conception which may be liberalized. It might be that from a certain set of propositions an absurdity is deducible but not in any obvious way. One might want to argue that psychologically speaking this might permit a coherent representation. (E.g. representing the possibility of a map that cannot be coloured using fewer than five colours.)

tingency of P only when the deduction of P from KΣ depends on some proposition of the form Kq for which the K–K principle fails, i.e. such that ¬KKq.

We may note two things. First, although failures of the K–K principle are ubiquitous, the cases of propositions P in which we are interested are unlikely to be sensitive to them. By Craig's theorem the cases of P that are deducible from the fact that Kq but not from q will have to be cases of propositions that concern S's own epistemic states. Secondly, although in such cases w_{INT} won't be coherently representable, S will not be able to know that. It will necessarily appear to S that w_{INT} is coherently representable.

So we can conclude that if P is epistemically possible for S then S can coherently represent a world where S knows exactly what S knows in the actual world and P is true. This holds with some exceptions that may be neglected; and even those exceptions will be such that the world in question will appear to S to be coherently representable. What this means is that we can simplify Kripke's mechanism for the explanation of apparent contingency in two ways. First, the subject need only consider a world that is like the actual world as regards KΣ not a world where KΣ* (where Σ* is not the set of propositions that S actually knows but is rather a set of propositions analogous to those). Secondly we can see that what is doing the work is just the epistemic contingency of the relevant proposition. This is perhaps what we expected all along, and certainly many authors have asserted that the illusion arises from a conflation of epistemic and metaphysical contingency. But Kripke is an exception in seeking to explain how. After all, the explanation cannot simply be that those who suffer from the illusion don't know the difference between epistemic and metaphysical contingency and blithely infer one from the other.

8.4 Imagination and possibility

I have just offered an improved version of Kripke's explanation how, given the unreliability of our intuitions about necessity and contingency, it is possible for necessary truths (such as those concerning the laws of nature) to appear contingent when they are in fact necessary. Nonetheless, the idea that there is a link between possibility and imaginability has been a popular one. Why should anyone have thought this? Is there some connection or other?

The following is a hypothesis about such a connection, which suggests that for certain simple truths there is a connection between imaginability and possibility, but that this connection breaks down for nomic truths. Simple creatures react simply to their environment as they find it. Only what is actual has any effect on them. Where those creatures have perceptual capacities, the effect of actuality is via perceptual representations of actuality. More sophisticated creatures need to think about possibility also: the possibility that either prey or a predator is hidden in the bushes, for example. One may hypothesize that consideration of possibilities and their role in influencing behaviour might be similar to, though weaker than, the manner in which actuality influences behaviour, that is, via perception-like representational states. This hypothesis would explain why it is natural to think of imaginability as a guide to possibility, and why it would be correct to think so to some extent. But the hypoth-

esis gives us no reason to think that imaginability should be an infallible guide. On the one hand imaginability is limited by representational capacities, so many possibilities will not be captured by the imagination. But this failure does not harm the adaptive benefit of imagination, since the possibilities knowledge of which are relevant to a creature's fitness (the possibility of a predator in the bushes) are ones that a cognitively well-adapted creature typically does have the capacity to represent. The unimaginable possibilities are often too remote to have an influence on a creature's fitness. In the other direction, more relevant to present concerns, the imagination will represent as possible situations that are not possible. This failure could well have an influence on a creature's fitness, since false positives (such as erroneous beliefs that there it is possible that there is prey to be found in the bushes or that a predator is near the watering hole) can have a deleterious impact. Even so, one should not expect adapted capacities to be perfect, just to be better than nearby alternatives.

An imaginative capacity that is more accurate with respect to possibility would require an adaptation that would prevent us from representing as possible an identity that is in fact necessarily false. It does not seem that any simple improvement to human powers of imagination could do this, since imagination (as employed in this context) is intensional rather than extensional. That is, how could one adapt the imagination so that it could not present Lois Lane with a picture, for example, of Clark Kent in one place and Superman in another place? Furthermore, even if an adaptation could occur that permits its possessor to see that alternative laws governing the same properties are not possible, there is no selection pressure that would bring such an adaptation into existence. For insofar as a creature's fitness requires a concern with laws (via a concern with causation), it can only ever be concerned with the laws we actually have (and impact upon it); whatever else is or is not possible is adaptively irrelevant.[132]

And so if the hypothesis is correct, that the link between imagination and possibility is explained by the adaptive benefits of such a link, we would have no reason to suppose that such a link should be reliable in delivering accurate judgments when applied to esoteric cases such as the contingency or necessity of laws. The functions of intuition, imagination, and common-sense are to guide us through the near-at-hand world of middle-sized dry goods, variability among which does affect our lives. We should not expect it to have much utility when faced with the science of the very small or very large (where it also fails us) nor with metaphysical questions.

8.5 Conclusion

Armstrong squares the circle by weakening the necessity (Lewis by largely ignoring it). But the correct approach is to embrace the necessity and to ignore the contingency as an illusion. This makes sense; since imaginability may outstrip possibility, it is more plausible that we are misled into thinking that a proposition is contingent when it is in fact necessary than vice versa. Indeed, if imagination was developed as a

[132] Of course, I think we do have an adaptation that allows us to know the impossibility of the relevant propositions. But this adaptation, reason, goes well beyond the power of imagination. And the power of reason appears to be a power that extends beyond the adaptive pressures that gave rise to it.

means to represent certain possibilities whose realization or otherwise would impact on our ancestors' survival, then one would expect it not to be a good guide to possibility when it comes to unchanging features of our environment (such as the laws of nature). Kripke provides strategy for explaining how a necessary truth can appear contingent. This applies as much to laws as to identities.

9

ARE THERE ANY LAWS, AND IF SO WHAT ARE THEY?

I begin this final chapter by addressing an argument for the conclusion that there are no laws, the position that Stephen Mumford (2004) calls 'lawlessness'. Mumford's argument is particularly pressing since he and I largely agree on nature's underlying metaphysics, that the ultimate explanation of why what happens does happen, of the existence of regularities, of the possibility of science, is the existence and nature of essentially dispositional properties. Mumford's view is that the efficacy of potencies in this regard shows that laws are otiose. I instead regard potencies as explaining what laws are. Mumford think that potencies eliminate laws since they usurp the role laws were supposed to fill. In effect his argument mirrors the eliminativist arguments one finds in science. Phlogiston was supposed to explain combustion. But since oxygen explains combustion, we may eliminate phlogiston from our ontology. Likewise laws are supposed to explain the existence of regularities and so forth. But if potencies do this, then we may eliminate laws.

Such an argument fails if in fact the supposed eliminator and the eliminated are one and the same or are otherwise closely connected. If a defender of phlogiston could make out that phlogiston is identical to oxygen or is appropriately related either to oxygen itself or to the way in which oxygen-based combustion occurs (e.g. phlogiston is equated with the existence of unbonded electrons in the outer shell of a substance's atoms), then the success of the oxygen theory not only fails to eliminate phlogiston but may even confirm its existence. Of course this is not in fact the case. Phlogiston's nature, had it existed, was that of a principle or substance present in combustible substances that is given off during combustion, and so cannot be identical with oxygen nor unbonded electrons. Thus for Mumford's argument to eliminate laws, he needs to show that laws would have some character that prevents them from being identical to potencies or closely related to them. In Mumford's view, that character is the fact that laws are supposed to govern their instances. Mumford argues that no adequate account of laws can sustain a governing role for them. In particular laws cannot govern if they are potencies, since that requires laws to govern what is in effect internal to them.

I shall argue first that the governing role is not essential to laws. Perhaps something else (e.g. potencies) governs, or at least explains, the world's events, and laws supervene on that something else. I shall then argue that even if laws must govern, then they could govern even if there are potencies.

It is sometimes hinted that the theologico-legal origins of our concept of natural law (laws of nature as the decrees of God) both provide a good reason for taking laws to have a governing role as a matter of conceptual truth while also discrediting the

concept of a law of nature. I disagree.[133] Concepts change over time and words can leave their etymologies far behind. We have to look to the current use and function of a term to discern the content of the concept it now expresses. The current use of the term 'law', in this context, is in science. Indeed, one might think that the role that the law concept plays in science is a good reason to think that laws must exist. Mumford argues, however, that there is no pattern to the scientists' use of the term'law', and that no metaphysically significant conclusion may be drawn from their use of it. I disagree here also. I do think that there are common features of what scientists call 'laws' and that they can be distinguished from other facts that play a similar role and which are termed 'principles', 'theorems', and so forth.

9.1 There are no laws?

9.1.1 *Mumford's lawlessness argument in summary*

Mumford's argument that there are no laws starts with a disjunction:

> (I) Either (I.a) laws have a governing/determining role, or (I.b) laws do not have such a role.

Response (I.b), says Mumford, is to adopt a *lawless* metaphysic. This is the conclusion that Mumford wishes us to reach. Clearly Mumford is committed, therefore, to:

> (I *bis*) *Real* laws (if they exist) have a governing/determining role.

In order to force us to the conclusion (I.b) and so to the view that there are no real laws, Mumford argues that one cannot satisfactorily give the nomologically realist response to (I), viz (1.a). If one does hold (1.a) then one is open to what he calls the Central Dilemma:

> (II) Either (II.a) laws are external to the properties and kinds they govern, or (II.b) they are internal to them.

Here 'internal' and 'external' correspond more or less to the essential/accidental distinction, or, better, the distinction between (metaphysically) 'dependent upon' and 'independent of'. Mumford argues that both (II.a) and (II.b) have untenable consequences. The undesirable consequence of (II.a) is this:

> (III) (II.a) is committed to quidditism.

The nature and faults of quidditism have been described in detail in Section 4.2. I concur that the external view of the relationship between laws and properties fails. Indeed that is the conclusion of Chapter 4. The undesirable consequence of the internal view of the laws, (II.b), is:

[133] I note that Helen Beebee (2000) argues that a non-governing conception of laws is perfectly legitimate, permitting a Humean account. She takes the nomological realist to assume that the 'governing' idea is part of the concept of a law of nature and argues that this is erroneous, stemming from the misleading jurisprudential analogy. As we shall see, Mumford proposes other sources for the governing idea. However, he does think that the jurisprudential metaphor infects the concept sufficiently for it to require rejection of the concept altogether (Mumford 2004: 201-5). Beebee does agree with Mumford to the extent that if the governing idea is part of the concept of law then there are no laws (Beebee 2000: 273).

(IV) (II.b) cannot explain how something that is internal to properties and kinds can govern them.

Thus we must return to (I) and accept disjunct (I.b). Mumford additionally provides reason to reject Humeanism and to adopt modally laden properties, giving his distinctively realist version of the no laws thesis.

In this brief discussion I will examine the strength of the Central Dilemma and the argument that accepting disjunct (I.b) of (I) involves accepting lawlessness. My view is that Mumford has not done quite enough to rule out a view of laws consistent with realism about modally laden properties.

There are two points in Mumford's argument where pressure may be applied. The first is in the inference from response (I.b) to the conclusion that there are no laws. The second is the claim in (IV), that a metaphysics of powers cannot accommodate laws that govern. In particular I will be concerned to see whether Mumford's arguments have any force against laws conceived of as supervening on the existence of potencies.

9.1.2 *Must laws govern?*

Mumford takes it that if one denies that there are laws that govern, then one denies that there are laws at all. Claim (I *bis*) is required for the second disjunct of (I) to lead to a lawless metaphysics. One might wonder why 'real' laws cannot exist without governing things. What is the basis for (I *bis*)? Mumford argues that the conception of laws as governing plays a central part in the realist's metaphysics. In this section I will maintain that Mumford's positive arguments for this claim are far from conclusive. Mumford does also provide a negative argument. This is that the metaphor of laws as governing is the only source of the law concept. It might be thought that the role of laws in science is an alternative source of the concept. But Mumford argues that nothing unifies the scientific uses of the term 'law', so science does not commit us to a metaphysically significant concept of law. I shall return to that argument in Section 9.2.

I agree with Mumford that a 'real' law should be metaphysically substantive in the way that Humean ('non-real') laws are not (see Section 4.3). Thus:

(V) A candidate for a law is 'real' only if it does not supervene on the Humean basis (the mosaic of particular facts, etc.).

Our question is, does a commitment to laws that are real also involve a commitment to laws having the governing/determining role? Mumford says that it does.

One source of such a commitment would be a positive argument for laws. Mumford points out that some nomological realists employ what he calls the Nomological Argument:

(NA_E)

There is a set *S* of features in the world;
There is *S* because there are laws of nature.

The set *S* varies in different versions of the argument, and may include: regularity, universality, explanation and prediction, necessity, counterfactuality (Mumford 2004: 70). If (NA_E) were one's reason for believing in laws, would one thereby be committed to (I *bis*)?

(NA_E) commits one at least to the view that laws explain their instances, for (NA_E) is implicitly an inference to the best explanation (hence my use of the subscript 'E'). A problem we now face is understanding what laws as explainers commits one to. For the DN model of explanation allows Humean 'laws' to explain, but these are not even real laws (in the sense of (V)). So if (NA_E) were one's source of the 'governing' conception of laws and the DN model were correct, then we would have to allow that even Humean 'laws' could govern, a view which is clearly inimical to Mumford. Presumably 'govern' must have sufficient content to rule out Humean 'laws' as being able to govern. Fortunately for Mumford, we have very good reason for supposing that the DN model is incorrect and that a more metaphysically loaded conception of explanation is required (e.g. one that appeals to causation, although that would not be quite appropriate here, since we do not think that laws are themselves causes). So one might be able to argue that if (NA_E) is one's reason for believing in laws, then one must conceive of laws as explaining in a metaphysically strong sense that may be enough to amount to governing.

That said, I do not believe that Mumford himself ought to regard (NA_E) as committing the nomological realist to a governing conception of laws. For Mumford does think that the relevant features *S* do have an explanation, only the explanation is not laws but potencies. But if he thinks that (NA_E) is committed to a governing conception of laws he must also think that his own view is committed to a governing conception of potencies. Yet, as we shall see he cannot think that potencies govern.

Thus (NA_E) commits one to a view of laws as explaining. But it is as yet unclear whether it thereby commits one to the governing conception of laws. For the purpose of this section I shall nonetheless assume that explanation is tantamount to governance and hence that (NA_E) would commit one to a governing view of laws. However, is (NA_E) one's only possible reason for believing in laws? Imagine that laws supervene on potencies. Then one's reason for believing in laws might be this:

(NA_S)

(i) The world contains *S* (premise);
(ii) If there are potencies, then laws supervene on them (premise);
(iii) The best explanation of *S* is that there are potencies (premise);
(iv) There are potencies (from (i) and (iii));
(v) There are laws (from (ii) and (iv)).

If so, then this argument may commit one to a conception of potencies as governing. But it does not obviously commit one to a view of laws as governing. Nonetheless, Mumford may insist that (NA_S) is not a common reason for believing in laws and so cannot be held to be informative as regards the concept of law.

However, it is unclear whether nomological realists really do employ (NA_E). Consider this argument:

(NA_C)

(i) The world contains *S* (premise);
(ii) If the world did not have laws, the world would not contain *S* (premise);
(iii) The world has laws (from (i) and (ii)).

(NA_C) is sufficiently close to (NA_E) that it would be difficult to show that nomological realists are committed to (NA_E) rather than (NA_C)). Some of the quotations from nomological realists that Mumford cites are closer to (NA_E), but many are closer to (NA_C). Indeed Mumford himself heads his sections employing the counterfactual form of (NA_C)): 'Without laws, there would be no order' (Mumford 2004: 72), 'Without laws, there would be nothing'(Mumford 2004: 74), 'Without laws, there would be no science' (Mumford 2004: 76). Furthermore he summarizes the nomological realist view in a counterfactual form thus:

> (VI) Laws must add something to nature such that the world would be significantly different were they not there. According to the realist position, a world that lacked laws would be a very different world from ours. (Mumford 2004: 145)

Since Mumford presents the nomological realist's case in ways that are better interpreted as (NA_C) than (NA_E), let us focus then on (NA_C) as the argument for laws. The key premise (ii) is indifferent between laws governing (explaining, determining, ...) things, as in (NA_E), on the one hand, and their depending on something else that governs (etc.), on the other hand. The problem for Mumford is that (NA_C), far from delivering a conception of laws as governing, is arguably consistent with *any* view of laws on offer. Consider even Lewis's regularity view. Since laws supervene on the history of the world, any change in laws (e.g. the non-holding of some particular law) would require a change in the basis, i.e. the history of the world.

However, Mumford could reply to the latter point, to get rid of some particular law, e.g.$\forall x(Fx \rightarrow Gx)$, might not require a very significant difference in that history. Just one F that is not G will suffice.[134] (VI) requires a *significant* difference. (For example, if a certain Armstrong law N(F,G) were not to hold, then a certain second-order relation between first-order universals will not obtain. And that is a significant difference.)

Nonetheless, even if (NA_C) rules out Humean 'laws', it is far from clear that it is enough to secure a governing conception of laws. Counterfactual dependence of *B*s on *A*s does not show that *A*s govern *B*s. Many kinds of counterfactual dependence do not imply governance. For example if *A*s supervene on *B*s, then a change in *B*s counterfactually depends on a change in *A*s (e.g. if mind supervenes on brain, then were my mind to be different, my brain would be different also). But *A*s do not governs *B*s—indeed *B*s might govern *A*s.

Even if we permit ourselves a metaphysics of governance, we may be able to acquiesce to (VI) without accepting that laws govern. For example, let *Y*s supervene on

[134] It is difficult to see, nevertheless, how there could be *no* laws at all on Lewis's view.

*X*s. If any change in *X*s yields a significant difference in the world, then a change in *Y*s will also yield a significant difference in the world (since a change in *Y*s must involve a change in *X*s). Now imagine that *X*s 'govern' the world and *Y*s supervene on *X*s. We could identify *Y*s with the laws and (VI) would still be true. In this set-up *X*s govern the world; would one want to say that the supervening *Y*s also govern the world? It is far from clear that one would, and certainly those worried by causal overdetermination in supervenience cases would be inclined to deny that *Y*s govern in addition to *X*s.

To sum up, it is far from clear that the nomological realist is committed to (I *bis*), the claim that laws govern. We focused on the proposed arguments for laws. An explanationist argument (NA_E) may well yield a governing conception, if 'A explains B' is sufficient for 'A governs B' (which I have assumed). However, the explainationist-cum-supervenience argument, (NA_S), and the counterfactual arguments for laws, (NA_C) and (VI), do not in any obvious way yield a governing conception of laws. Even if something in the world does govern, the counterfactual arguments would still hold for laws as conceived of as items that supervene on the things that govern.

I will briefly mention a second argument in Mumford for laws as governing or determining the world:

> (VII) Real laws . . . would play some role in determining the world's history, rather than vice versa. The opposite view—Humean supervenience—claims that laws play no distinct and irreducible role at all. They are entirely supervenient on . . . what happens in the world (Mumford 2004: 145).

Argument (VII) explicitly presupposes the following disjunction:

> (VIII) Laws (real or otherwise) either determine the history of the world or are determined by it.

Since *real* laws couldn't be determined by the world's history (thanks to (V)), (VIII) tells us that they must determine it.

But (VIII) is by no means obvious. If laws floated free and fully independent of the history of the rest of the world (VIII) would be false. While that is a false view of laws, it is unclear why one must take one of the extremes offered by (VIII) rather than some intermediate position. Consider the following arrangement:

> (IX) *X*s determine the history of the world. *Y*s supervene on *X*s.

Do *Y*s also determine the history of the world? Trivially they do if *Y*s are *X*s. But we are interested in a non-trivial case where possible candidates for laws fill the role of the *Y*s and are distinct from whatever it is that actually determines the history of the world. For (VIII) to be true, any *Y*s that are plausible candidates for laws will have to determine the history of the world even though they supervene on distinct *X*s that also determine the history of the world. As above, those who have concerns about overdetermination will reject this.

9.1.3 *Could laws be or supervene on potencies?*

I now wish to turn to the Central Dilemma, (II). I agree that external accounts of laws (e.g. Armstrong's) face insurmountable objections.[135] Of greater current interest is the second horn of the dilemma, the claim that internal accounts of laws also face problems. Here the objection contained in (IV) is that something that is internal to properties and kinds cannot govern them.

In this section I want to ask whether there is, after all, anything wrong with the governing conception of potencies, and, more generally, whether there is anything wrong with the view of laws as both internal and governing. If there isn't, then claim (IV) of Mumford's lawlessness argument fails and the way is open for a view of laws as internal to properties and kinds. We may regards laws as identical with or supervenient on potencies.

In arguing against internal account of laws, Mumford argues against three ways of thinking about an internal account: reduction, supervenience, and constitution. The general form of the argument is this: how could something govern that to which it is reduced or upon which it supervenes or by which it is constituted?

I start by noting that Mumford has a problem if he thinks that his argument is good against *any* reductive account (which he seems to: 2004: 153). For a reductive account will typically say that a law is identical to some X where X is of a category upon which we have some independent grasp. If there is identity, then what is true of laws will be true of Xs and vice versa. Let Xs be potencies, then either both laws and potencies govern or neither do. If both do, then Mumford has relinquished (IV) and hence horn (II.b) of the Central Dilemma. (And Mumford (2004: 197) does allow that potencies do govern—they are self-governing.) On the other hand, if Mumford denies that neither govern, then he is denying that potencies govern. Mumford does regard potencies as explaining the features S of the world that are mentioned in (NA_E). So it would look as if potencies can explain features S without governing. In which case he cannot claim that the explanationist argument (NA_E) commits its users to a governing view of laws.

Mumford holds that the general form of the argument against reductive (and also supervenience and constitution) accounts is one found in the common criticism of regularity accounts of laws, viz. that because such laws are identical with regularities they cannot explain those regularities, nor their instances.[136] There needs to be some metaphysical distance between one thing and another if the first is to explain (or govern) the second. Something cannot explain or govern itself. Similarly, if laws are to be identified with the essences of properties or some aspect thereof, or supervene thereupon, they cannot govern those properties.

These arguments are not, however, analogous. This is because there is an ambiguity in claiming that laws are supposed to govern *properties*. In a weak sense laws govern properties merely in that they *concern* or *relate* properties. But this is clearly too weak to generate any problem analogous to the argument against Humean laws.

[135] See above, Sections 4.2 and 4.4. Cf. Bird (2005*c*) and Bird (2005*b*).

[136] See above Section 4.3.2. Cf. Armstrong (1983: 40-1).

There is no difficulty in saying that the latter concern their instances or relate them (via generalization). What is needed for the analogy (and what, I am sure, Mumford intends) is a stronger sense of 'govern' that encompasses or is at least analogous to 'explain' and perhaps involves the idea of determining the behaviour of things. But in this stronger sense, what laws govern (if anything) is the possession, acquisition, and loss of properties by particulars. And that involves more than the properties alone. Let us consider Newton's law of gravitation. It relates the masses of objects and their displacements to the gravitational forces between them and thereby, via the laws of motion, to their accelerations. But what is governed are not these quantities *tout court*, that is to say, the universals. Rather it is the possession of these quantities by individual massy entities, such as the planets in the solar system. As Mumford says (Mumford 2004: 145) 'Real laws in nature . . . would play some role in determining the world's history.' It is the entities and events making up the world's history that get explained and governed by the laws. But neither are the laws internal to those things nor vice versa.

Above, in Section 3.1.2, I sketched how laws derive from potencies. Since a property P is essentially dispositional, then necessarily, if some x possesses P and receives appropriate stimulus S, then it will yield its characteristic manifestation M. Generalizing, $\forall x((\mathrm{P}x\&\mathrm{S}x)\rightarrow\mathrm{M}x)$—and so we have the regularity that is characteristic of the law (which may need a *ceteris paribus* clause). We see how the law is internal to the property—it flows from the essence of the property. That dispositional essence can govern or determine things, as just mentioned, for it makes it the case that should something possess the potency and experience the stimulus then there will be a manifestation. But that set of events is itself external to the power and the law.

Let us turn now to Mumford's (2004: 155) rhetorical question against the supervenience approach, 'How could something govern, or play a governing role in, that upon which it supervened?' If we consider a little bit of world history that is some object's possessing P, its receiving stimulus S, and then manifesting M, then the law in question does supervene on this history, because the potency P is itself part of the history and the law is identical with or supervenient on P (cf. Section 4.3.1). However, I think Mumford's implicit claim, that something may not govern any part of that upon which it supervenes, is too strong. Let us imagine that F determines or governs G but does not supervene on G. Now consider the mereological sum of F and G. Clearly F supervenes on that sum but determines part of it.

Immediately before the question quoted in the last paragraph, Mumford asks this: 'How could something govern, or play a role in determining, that by which it was constituted?' This is quite a different question. For F supervenes on the sum F+G but is not constituted by that sum. (To be constituted by part of X is not to be constituted by X.) But now note that the implied principle does not rule out governing or determining in the case of potencies and histories. For the potency P may trivially supervene on a history which involves something having that property. But that history does not constitute P. This allows us to say what is wrong with laws-as-regularities explaining regularities and their instances, since in that case the law is constituted by what it allegedly explains or determines.

9.1.4 *Conclusion—are there laws?*

Mumford's lawlessness argument may be resisted. He says that real, genuine laws must govern, and that they cannot do this if they are potencies or supervene upon them. I have argued that laws can govern even if they are potencies or, more relevantly, if they supervene upon them (which is the view I shall later argue for). I also argued that we are not obviously committed to the view that real laws do govern. We may discern what our concept of law commits us to by examining its function. That may be revealed by the arguments we give, as realists, for thinking that laws exist. The arguments were of two sorts: inference to the best explanation and counterfactual. The most that the former commits us to is laws as explainers, and the second doesn't obviously commit us to even that. 'Governing' and 'determining' seem to be stronger concepts than explaining, so it isn't clear that we are committed to a view of laws as governors. When we further consider that even if we do allow something to govern, laws do not need to be regarded as identical to that something but instead supervene on that something, it is even less clear that we are obliged to regard laws as governing.

We can safely conclude that the view that laws supervene on potencies does not fall foul of Mumford's argument. Potencies are the ultimate explainers. Laws supervene upon them. Do laws also explain then?

I don't think it much matters how we answer that question. On the one hand we might have concerns of the overdetermination type already mentioned. If potencies are the explainers then laws cannot be also. We would still have reason to believe in laws, because we have reason to believe in potencies; this is argument (NA_S). Or we could employ the counterfactual argument (NA_C). This view would aim to defeat Mumford's lawlessness argument by asserting that we can have reason to believe in laws without holding them to have a governing or explaining role (i.e. it employs the arguments in Section 9.1.2).

One disadvantage of this approach would be that it is in tension with the rejection of the regularity theory of laws in Section 4.3.2. That argument showed the theory to be inadequate because it couldn't allow laws to be explainers. It thus assumed that an adequate account of laws would allow laws to be explainers. Nonetheless, the tension can be fairly easily resolved. We ought to concede that it certainly seems as if laws can provide explanations. But overdetermination shows that this is an illusion. Even so the illusion exists only because something else, the potencies, do the explaining instead. The laws are standing proxy for the potencies. However, in the case of the regularity theory, the laws are not standing in for anything else. According to that theory the laws supervene on the total pattern of particular matters of fact, and that cannot be the explanation of anything.

A more relaxed conception of explanation allows explanatory power to be inherited. Laws can explain in virtue of their being themselves explained by potencies. This view simply rejects overdetermination worries for explanation. It permits the explanations we in fact employ to be genuine explanations despite not referring to fundamental properties. It is thus a less revisionary approach than that just outlined, which is why it is my preferred option. If explaining amounts to 'governing', then this

option cannot reject Mumford's lawlessness argument on the basis of the arguments in Section 9.1.2, which aim to show that we need not adopt a governing conception of law. Instead his argument must be rejected on the basis of the argument in Section 9.1.3 to the effect that the fact that laws supervene on potencies does not cause trouble for their ability to explain or govern.

9.2 Does science use laws?

So far I have considered Mumford's principal argument against the existence of laws, which is premised on the claim that real laws govern. That claim is supposed to be a product of the nomological argument for laws. But we might have another reason to believe in laws, which does not have this implication, viz. that many areas of science employ talk of laws. If we take those areas of science seriously and regard them at least as reasonably well confirmed by the evidence, then we should regard the proposition that there are laws as well confirmed also. Mumford disputes the view that science gives us reason to believe in laws. He discusses the point in this way. If there are real laws in nature, we should expect them to form a natural kind. But they do not. This is shown by looking at the diversity of statements that have been called laws while also noting the fact that many ostensibly similar statements are not called laws. Here are Mumford's contrasting lists:

Laws:

- Coulomb's law
- Boyle's law
- Kepler's laws
- Newton's laws of motion
- Henry's law
- Hess's law
- Kirchoff's laws of electrical circuits

Non-laws:

- Goldstone's theorem
- Fermat's principle
- Ergodic hypothesis
- Einstein's equation
- Gravitational constant
- Hund's rules
- Pauli's exclusion principle
- Bernoulli's theorem

Parenthetically I note two things. First, it is somewhat odd to talk of laws as forming a natural kind. Secondly, that fact that something is not called a 'law' does not mean that it is not a law, and equally, the fact that it is called a 'law' doesn't mean that it is a law. Even so, I think there is an important unity (natural or otherwise) among the statements described using the term 'law' which is not shared by those not so described. The unity is this:

> Relative to a particular field and the state of knowledge concerning it, S is held to state a law only if:
>
> 1. it states a reasonably general relationship between quantities and properties;
> 2. it seems to state a relationship that is close to fundamental;

3. it is a new discovery, not easily deducible from known laws;
4. it has a wide application in predicting and explaining phenomena;
5. the relationship seems necessary rather than accidental.

While I have listed these only as necessary conditions, they may also be jointly sufficient. I'll briefly explain their significance. The significance of (1) is obvious—it is agreed on all sides that laws, if they exist at all, should have some kind of generality. This may be expressed in a universal generalization (perhaps qualified) or as a relationship between kinds and quantities. Either way, the value of the gravitational constant is excluded as a law in itself, although it may be part of a law.

For something to be held to be a law it should be fundamental *relative to a particular field and the state of knowledge concerning it*. In Newtonian mechanics, Newton's laws are fundamental. Bernoulli's theorem, which relates pressure, velocity, and elevation for fluid particles an inviscid fluid however, is not fundamental; indeed since it is a theorem it is derivable from more fundamental principles or laws, primarily the law of conservation of energy. Einstein's $E = mc^2$ and the Goldstone theorem are other such cases. In some cases what are called laws may be derived from more general laws yet still be called laws since they are fundamental *for that branch of science*, as in the case of Kirchoff's laws, which are regarded as the basic laws governing electrical circuits. Of course, what is held to be fundamental at one time may well be derivable from yet more basic facts discovered later, as in the case of Kepler's laws, later derived from Newton's, Boyle's law, later superseded by the ideal gas law, and Henry's law, later subsumed under the Nernst partition law. What entitles Kepler's laws and Henry's law to be called laws is their status of being fundamental relative to the contemporary state of knowledge. Since what are taken to be laws are fundamental to a branch of science at a given time, they will typically be new empirical discoveries, and not readily deducible from other laws, unless those other laws are outside the branch of science under consideration. Boltzmann's ergodic hypothesis is not an empirical generalization; rather it is an assumption that he needed to facilitate the derivation of his H-theorem. It also does not have a wide explanatory application it its own right, what applications it can be said to have are indirect.

Pauli's exclusion principle is an interesting case, since it would at first sight seem to meet these criteria, for it is a principle that plays a significant explanatory role in quantum mechanics but without being derivable from other laws of physics, at least not in 1925 when Pauli first formulated the principle as an empirical discovery. In fact, as Pauli himself proposed, the principle can be derived from the assumption that a collection of particles must occupy antisymmetric quantum states. But the status of that assumption itself may be questioned. (Apparently it *can* be derived within relativistic quantum mechanics.) What I think precluded the exclusion principle from being named a law was Pauli's conviction, widely shared, that it had to have an explanation within quantum mechanics. Thus Pauli himself would have regarded, almost certainly correctly, his principle as in all likelihood failing to satisfy criterion (2).

As one would expect with fundamental principles, they should have a wide range of explanatory applications. Principles may have a wide application without being

explanatory. Hund's rules are like this, in that they are regarded as a useful means of finding the quantum numbers for the ground states of atoms. But, being tools of calculation, they don't have any explanatory power. Something similar, I suggested, is true of the ergodic hypothesis. I think also that this applies to Fermat's principle. Fermat's principle is an instance of a least-action principle. Least-action principles often permit the reformulation of a theory in a mathematically flexible and elegant manner. Nonetheless, in the case of Newtonian mechanics, we are not able to derive anything more than we were able to derive using Newton's formulation. In that sense we are not obliged to regard least-action principles as satisfying criteria (2) and (3). Furthermore, least-action principles are explanatorily odd. In the case of Fermat's principle, how does the light ray know which path is the quickest? Fermat's principle is readily shown to be itself a consequence of the way light propagates as a wavefront. The latter seems an explanatorily more satisfactory story. Hence it is tempting to regard least-action principles as mathematical tools rather than as explanatory laws.

Lastly, we expect laws to be necessary rather than accidental. What exactly 'necessary' amounts to here is not fixed, I think, simply by the *a priori* content of the concept of a law of nature. At most we have the idea that the generalities in laws are not merely accidental. Indeed this much may already be contained in the requirement that laws be explanatory. It is up to metaphysics to work out what exactly this necessity or non-accidental-ness is.

9.3 What laws are

In Section 9.1 I contended that Mumford's argument against the existence of laws does not exclude every plausible view of laws. Mumford and I agree that the existence of regularities in nature, the truth of counterfactuals, and the possibility of explanation are explained by potencies. I have argued that his argument does not exclude the possibility that laws are to be identified with such potencies or supervene upon them.

The claim that laws *are* potencies is implausible for an independent and more obvious reason: it seems wrong to say that laws *are* properties. Coulomb's law is not identical to the property of charge. Rather it concerns that property and its relations to other quantities. Any positive account of laws needs to respect this feature, that laws are, at least in a loose or abundant sense, a relation among properties. The nomic necessitation view of Armstrong, Dretske, and Tooley respects this requirement to the greatest extent, by making laws a matter of a sparse, natural relation between universals. The regularity theory takes laws to be a relation of extensional inclusion: the extension of one property is included within the extension of the other. We need not take extensional inclusion to be a sparse relation, even if supplemented with systematic requirements *à la* Lewis. Even so we can see that laws concern sets of properties and a specific (abundant) relation among them.

What we should take from Section 9.1 is, then, that laws are general relations among properties that supervene on potencies, and which have explanatory power, even if that power is inherited from the potencies. When in Chapter 3 I sketched how potencies could account for the laws of nature, I showed how at the very least one

could derive relations of extensional inclusion from their essences. At that point I said no more in detail about what laws are. We have now begun to rectify that omission. But more needs to be said. The general relations will be abundant; Mumford is right that laws are no addition of being beyond potencies. Because they are abundant relations we need to identify more precisely which relations they are.

In Section 9.2 I argued that there is a unity to what are called laws. Of course, taking something to be a law doesn't make it a law, and what we regard as fundamental will change over time as we make new discoveries. Kepler's laws would not have been called laws if they had been discovered after Newton's laws—they might have been called Kepler's 'rules' or, if known by being derived from Newton's laws, Kepler's 'theorems'. In my view, when a relationship becomes known as 'X's law', that phrase operates as a name rather than as a definite description. Hence some relationship will keep that name even if later it is believed that it does not possess the relevant features of being fundamental, explanatory, necessary and so on. Thus Bode's law, also known as the Titius–Bode law, is still so-called even though it is widely believed to be merely accidental. By looking at the circumstances in which we attach the label 'law', even if it thereby becomes a name attached to non-laws, we can tell what characteristics we think a law should have, i.e. which relations we take to be the nomic relations among properties to be. What Section 9.2 revealed was that the characteristics of a nomic relation are that it should be a general, explanatory, and non-accidental relationship among properties and one that is fundamental and not derivable from other such principles.

However, when in that characterization we say 'fundamental', that fundamentality is not absolute but relative to the field in question. Thus the properties being related will not be the fundamental potencies that have been the focus of this book. Furthermore, although I reject the view that laws are to be understood in terms of natural kinds, it is nonetheless true that kinds, including kinds that are not absolutely fundamental, can figure in laws. But those facts are no obstacle to combining the conclusions of Sections 9.1 and 9.2 in an account of laws. For the properties and kinds related in non-fundamental laws ('fundamental' being understood here in an absolute sense) will have explanations and essences to be found in deeper laws beyond the domain in question.[137] (This is a metaphysical claim, not an epistemic one. The programme of *scientific* reductionism is unlikely to be universally successful.)

We are now in a position to state what a law is:

> (L) The laws of a domain are the fundamental, general explanatory relationships between kinds, quantities, and qualities of that domain, that supervene upon the essential natures of those things.

[137] This may seem to contradict the account of kinds I will sketch in Section 10.2 which would seem to allow that some kinds, biological kinds in particular, do not have essences. I'll make two remarks. First, biological kinds tend not to appear in laws, and so their lack of an essence, if that is right, would not damage an account of laws that appeals to essences. Secondly, it is not entirely clear that biological kinds do not have essences. It could be held that the relevant arguments establish only that if biological kinds have essences, then the essential properties of the kind are not intrinsic properties of the members of the kind.

This account captures the desired features of laws:

(i) laws are general relationships;
(ii) laws are fundamental relationships;
(iii) laws are domain-relative;
(iv) laws supervene on the basic metaphysical explainers (potencies);
(v) laws reflect the essential rather than accidental features of potencies and kinds.

9.4 Conclusion

Mumford raises two important arguments against laws relevant to the central claims of this book. First, if one's fundamental metaphysic is one of potencies, then one should abandon laws. Secondly, science does not use laws. We can resist both arguments. The core of the first argument was that laws, if they exist, govern. But if potencies are doing the governing, we don't need laws also. My response was that even if potencies do govern, that doesn't require us to exclude laws. Laws in my view supervene on potencies, and so exist if potencies do. Indeed, it is not obvious that this supervenience relation prevents laws from having at least an explanatory function, and, depending on what you think 'governing' amounts to, perhaps a governing role also. Nonetheless, I must agree with Mumford to the following extent. One might take the reality or existence of laws in a strong way, to indicate that laws are somehow fundamental and non-supervening features of ontology. Armstrong's account would satisfy that conception, whereas Lewis's would not. Neither would mine, since it takes laws to be supervenient features of the world. But that seems to me to be too strong a criterion for existence, since it would rule out most macroscopic entities and properties that we naturally take to exist.

That last claim does not mean either that we must accord the same *mode* or *kind* of existence to all existing things. Nor does it mean that we must accept into our ontology on a par with its fundamental components any gerrymandered object or property we may consider. Thus we may wish to make a three-way distinction between fundamental natural entities, supervening or non-fundamental natural entities, and non-natural entities (recall Section 2.1.1). Potencies fall into the first category while laws fall into the second. I surmise that it is to cast doubt upon even the latter claim that Mumford denies that laws form a natural kind. If he were right, laws would form a rag-bag, disunified, and non-natural class. Worse, it might be that there is no kind of thing it is to be a law at all. At best there are only statements, some of which get called 'laws' while others don't, with no clear distinction. Either way laws would have no place in a metaphysics designed to further our scientific understanding of nature, which is what this book aims to provide.

Thankfully, there is more of a pattern to how things get called 'law'. However, when something gets called 'X's law' that name tends to stick whatever subsequent developments in science happen to occur. So it won't do to look at all the propositions that are called 'law' and then to try to discern some scientific or metaphysical unity among them. What we need to do is to look at the circumstances surrounding their first being dubbed 'law' to see what criteria their dubbers implicitly employed

in so doing. This contextualized investigation does reveal a unity to what people are willing to call laws: they are willing to regard a proposition as asserting a law if, as far as they then know, the proposition correctly states a general and non-accidental relationship among properties (including quantities), where that relationship plays a fundamental, explanatory role in the relevant scientific domain. That investigation of usage reveals that there is a unity to the concept of law, but it cannot tell us what the underlying metaphysics of laws is. That is what the defence of the dispositional essentialist view is supposed to achieve. A full account of what laws are should identify the underlying metaphysics while satisfying, fairly closely at least, the concept of law as revealed by its use. The account (L) of laws in Section 9.3 does just that.

10

CONCLUDING REMARKS

10.1 Review

To conclude I shall start by reviewing the principal theses I have attempted to articulate and defend in this book. I shall then go on to address the further work that needs to be done on the view I am promoting. I'll start with the central claim:

> (i) That some natural properties are *potencies*—properties that have dispositional essences.

To subscribe to (i) is to be a dispositional essentialist. Strictly one ought perhaps to say that one has a dispositional essentialist view of such-and-such a property or class of properties. But such a view is sufficiently controversial that to hold it of any properties at all deserves special notice, and hence the term has been applied to anyone who thinks that at least one property has a dispositional essence. The properties we are thinking of are not abundant properties, but the natural (also known as *sparse*) ones. I have suggested that this distinction corresponds in some way, even if not directly, to the distinction between properties that are identical with universals and those that are not. It is up for grabs whether all natural properties are universals, or just the fundamental ones. While I prefer an account of natural properties in terms of universals, if you think that tropes do the trick better, then so be it. The important thing is that the fundamental properties at least belong to an ontological category that abundant properties do not belong to, and a more basic one at that—basic in the way that bona fide material particulars are basic relative to arbitrary mereological sums of such particulars.

Dispositional essentialists claim, then, that some universals (or tropes if you prefer) have essences that may be characterized dispositionally. What about the rest then? Let us focus on the fundamental properties since these are the ones that are causally (or nomically) non-redundant, and which will suffice as a supervenience basis for all the rest. Most dispositional essentialists hold that there are categorical properties too among the fundamental ones. They subscribe to what I have called the mixed view, contrasting with, on the one hand, categorical monism, and, on the other, dispositional monism. The latter is the view I defend here, summarized thus:

> (ii) All fundamental properties are potencies—there are no (fundamental) categorical natural properties.

An advantage of (ii) over (i) is that it permits one to argue that any view that permits categorical properties at all is committed to *quidditism*. Quidditism as regards some class of properties holds those properties to have primitive identity—the identity of a quidditistic (categorical) property does not depend on its having some causal

or nomic role. Consequently, categorical properties may be swapped to produce a new possible world. But if you agree that two worlds that are identical as regards the pattern of the distribution of their causal powers and differ at most in which properties fulfil those powers, are in fact identical *tout court* then you reject quidditism, and have a reason to reject both categorical monism and the mixed view in favour of (ii).

An advantage of dispositional monism (and of some versions of the mixed view) is that it provides the foundation for an account of the laws of nature:

(iii) The laws of nature are consequences of the existence of potencies.

But since potencies have the same powers in all possible worlds where they exist, (iii) has the consequence:

(iv) The laws of nature are necessary.

Dispositional essentialists tend to take (iv) in the sense that there is no world in which there is a counterexample to an actual law of nature, allowing for worlds in which the relevant potencies do not exist. It is worth reflecting that a stronger view is at least consistent, that all possible laws exist in all possible worlds, a view that is natural if one takes a transcendent, Platonist view of universals. Such a view is not mandatory on my account, but I do regard it as an attractive option for the dispositional essentialist.

The necessitarian view of laws has advantages over its two main rivals, the regularity view and the contingent nomic necessitation view, beyond the fact that those views commit themselves to quidditism about properties. The principal problem even with the sophisticated, systematic regularity account is that laws fail to explain their instances. Indeed on the regularity view, nothing explains the instances of laws. They just *are*. This is not a new criticism. What is new is my criticism of the contingent nomic necessitation account. The accusation is that it cannot get by with categorical properties and relations alone. In order to account for the relation between laws and their instances, at least one property or relation is required that has its character of necessity rather than contingently imposed by a law.

Potencies have seemed strange entities to their critics. They appear to involve entities or states of affairs that do not always exist—their manifestations. And even when the latter do exist, potencies seem to *point towards* those manifestations. These considerations together suggest that potencies have as part of their essence a nature that is both Meinongian and intentional in character. Both aspects are unappealing, especially from a naturalistic point of view. The Meinongian element, it would be argued, should be excluded for implying the existence of non-actual entities, while the intentional element is undesirable precisely because the intentional is something that needs explanation in non-intentional and preferably physicalistic terms rather than being built into the essence of fundamental natural properties. Indeed the two problems might seem to be the two sides of the same coin, since the possible inexistence of the object of a state is one characteristic of that state's being intentional. But that is a mistake. The possible inexistence of the manifestation is a genuine issue,

but intentionality is not. The potential inexistence of the object of some state is not a sufficient condition of intentionality:

(v) Potencies do not display any species or analogue of intentionality.

The fact that potencies seem to require the existence of something that can be merely possible, an unrealized manifestation, does, by contrast, need to be addressed. But in this case the problem is not unique to the dispositional essentialist. Indeed it is a problem that must be addressed by anyone except the radical, revisionary Megarian actualist whose denies that *X* is possible unless *X* is actual.

(vi) Insofar as potencies require the existence of unrealized manifestations, parallel problems afflict all views that are not radically actualist.

Given the relationship between dispositions and counterfactuals, the question of unmanifested dispositions is the same as the issue of proper counterfactuals (ones whose antecedent and consequent conditions are false). The difference between the dispositional essentialist and a proponent of Armstrong's view is that the relationship to a counterfactual is essential to the property alone for the former whereas it is essential to the combination of the property and a law for the latter. Either way something or some combination of things that are actual seem to require the existence of the merely possible. Pointing this out should be sufficient to deflect this criticism.

Since the problem is general and afflicts the opponents of dispositional essentialism, it is not especially incumbent on me to provide an answer. Nonetheless, I do suggest a way forward. One way—which I am not espousing—is a Meinongian acceptance of some kind of existence for things that do not fully exist or are non-actual. The association with the name of Meinong seems to damn a view in the eyes of many before it has been properly considered. But if you are not a Megarian actualist but think that mere possibilities are non-actual, then you are inevitably committed to a view that has a Meinongian character. Such views come under the heading of possibilism, of which Lewis's modal realism is the leading exemplar. Lewis's view is Meinongian, since it accepts the existence of things (worlds and their contents) that are non-actual. If we reject modal realism we are forced to regard mere possibilia as components of the actual world. This view, the one I put forward, is actualistic—everything is actual—and is thus less Meinongian than possibilism. But some actual things are concrete (contingent particulars) while others are abstract (necessarily abstract objects such as numbers, and contingently abstract entities such as unrealized entities and states of affairs). I emphasize that I propose this as a solution to a *general* problem that goes well beyond dispositional essentialism, a solution which my opponents need as much (or as little) as I do.

A commonly expressed complaint against dispositional monism, that is related to the modal worries just mentioned, is that if each property has its identity fixed by its dispositional relations to other properties, then this criterion of identity is impredicative and will lead to all the problems of vicious circularity or regress associated with impredicativity. Such critics say little more than that—they do not show that no criterion of identity can be impredicative; they do not show that identity cannot su-

pervene on the pattern of inter-property relations. Once the problem is formulated in graph-theoretic terms it becomes easy to see that it is massively overstated because:

> (vii) It is possible to have networks of properties that are sufficiently asymmetrical (they have no non-trivial automorphisms) that the identity of each property is determined uniquely by its place in the overall network.

Since I espouse dispositional monism—all fundamental properties are essentially dispositional—one avenue for attacking my view is to raise cases of properties that appear to be counterexamples. 'Structural' properties, spatial and geometrical properties in particular, plausibly look to be such cases. Two things should be noted. First, many such properties are unlikely to be fundamental properties. Secondly, insofar as they are they are no less theoretical properties than other properties. However, being theoretical properties does not guarantee that they can be characterized dispositionally. The fact that they appear in laws might seem to make that possible: a spatial displacement r is that relational between two points whose stimulus is two objects of masses m_1 and m_2 placed at those points and whose manifestation is a force of magnitude Gm_1m_2/r^2. But this seems artificial. However, we need to realize that the tendency to see displacement as being passive, playing no causal role, is a product of a tendency to portray spacetime as mere background. This is a product of a Newtonian substantivalist absolutism. The modern inheritor of relationalism is the call for background-free physical theories. General relativity removes much of the background that is present in Newtonian mechanics. As a consequence the structure of space is both a cause (of motion) and an effect (of the presence of mass). I therefore conclude that:

> (viii) The elimination of background structures from physical theories favours a dispositional essentialist account of physical quantities.

For many, a principal obstacle to accepting dispositional essentialism is the consequence that the laws of nature are metaphysically necessary, which contradicts the widely held intuition that they are contingent. But the fact that one may imagine laws to be false is no good reason to think that they could be false. The relevant sense of imagination fails to support such modal conclusions, whereas if we adopt a more robust notion that may have such implications, it has not been shown that we have imagined the falsity of the laws. Indeed the failure of our intuitions on such matters can be shown in particular cases. And it is no surprise that imagination is a poor guide to the modality of laws, if one supposes that the power of imagination evolved to allow us to think about the sort of possibilities—concrete, perceptible states of affairs that we might actually come across (predators in the bushes)—rather than esoteric possibilities (if they really were such) we would never experience such as a world with different laws. It can be shown how Kripke's explanation for the illusion of contingency can be extended to laws.

The above goes some way to establishing dispositional monism as a plausible account of our properties and laws. However, one might wonder whether the success of the view as an account of properties obviates the need for an account of laws at all. That, in short, is Stephen Mumford's objection and the basis of his lawless view. I

respond that it is possible to have a conception of law that is on the one hand supervenient on the essences of properties, so that laws are not, in that sense, ontologically fundamental, while on the other hand leaving laws with sufficient robustness to resist the accusation that they cannot govern or explain things. For a full account of laws, one should link one's metaphysics of laws to the role that laws play in science. Mumford contends that there is no single, unified role that laws play. But I disagree. The statements that bear the name 'law' are those that scientists take, or did take, to express fundamental and general relations among the properties and quantities of the relevant field. We may combine the metaphysics provided by this book with the following account of laws:

> (ix) The laws of a domain are the fundamental, general explanatory relationships between kinds, quantities, and qualities of that domain, that supervene upon the essential natures of those things.

10.2 Further work—natural kinds

The view of properties I propose here is in many ways similar to that of Brian Ellis (2002). And agreement on this important point may obscure significant differences. For one thing, our agreement is imperfect—Ellis accepts that there are categorical properties in addition to potencies; he adopts the mixed view rather than dispositional monism. Furthermore, Ellis's account of the laws of nature is rather different. Ellis (2002: 85) gives a central place in his metaphysics to *natural kinds*. 'The laws of nature,' he tells us, 'are explications of the essential properties of the natural kinds.' That would be no different if every natural kind were a natural property and vice versa. But that is far from being the case. The property of being negatively charged is a natural property, but negatively charged objects do not form a natural kind, for two reasons. First, the class of negatively charged objects is too diverse, including electrons, chlorine ions, raindrops, and metal spheres. Secondly, an object's natural kind is generally held to be an essential feature of that object, whereas all but the electrons in the list just given can lose their negative charge with ease.[138] It might be that every natural kind corresponds to a natural property—electrons form a natural kind of entity, and being an electron does look like a natural property. But this natural kind does not seem to generate any natural laws. One might say that 'electrons repel other electrons' or 'electrons in motion through a magnetic field deflect thus and so' are laws of nature. Nonetheless, those laws are derivative from more basic laws about the behaviour of negatively charged objects plus the fact that electrons are negatively charged. The latter fact is not itself any kind of nomic fact. It is part of the essence of an electron that it is negatively charged, but that is not a law of nature (likewise it is not a law of nature that water is H_2O—water just *is* H_2O). So the laws in question are

[138] To this Ellis might respond as follows. According to his view, the natural kinds divide up into the natural kinds of (i) objects and substances; (ii) events and processes; (iii) facts about the intrinsic natures of things (which include properties and structures). Laws of nature are correspondingly categorized. In focusing on the property of being negatively charged I have picked something from category (iii). But it will still be the case that being negative charge is a property, not a natural kind of property. The laws governing negatively charged objects do so in virtue of the essence of the property itself, not of any kind of property.

derivative rather than fundamental laws, and the underlying laws hold in virtue of the properties rather than the natural kinds.

For similar reasons I reject E. J. Lowe's (2006) account of laws, which takes them to have the form 'K is F' or 'Ks are F', where 'K' is a substantial kind term; his examples include 'planets move in elliptical orbits', 'electrons carry unit negative charge'. The latter is not a law at all. The former is a law, but the mention of the kind 'planet' (if it is a kind at all)[139] obscures the *real* law at work here, which is the law of gravitation or whichever laws underlie it. So while Kepler's first law refers to the alleged kind 'planet', Newton shows how that law derives from his law of gravitation in a way that draws on no special feature of planets. *Anything* in orbit about the Sun will move in an ellipse so long at it is much less massive than the Sun. Newton's law does not mention any natural kinds. One could say that it concerns the kind 'material object', but that is an artificial and indeed unnecessary restriction.[140]

However, the central place given to kinds by Ellis and Lowe does raise the question, whence do natural kinds, on my view, arise? An interesting question is whether there *have* to be natural kinds. Could there be a world where particulars are subject to laws but do not divide into different natural kinds of particular? The non-trivial solutions to the Einstein field equations look like this, with different points in space varying their values of the stress-energy tensor, but having no essential properties other than those they possess in virtue of being a point in spacetime. There would be a maximal natural kind of all particulars (all spacetime points), but that would be it (Boscovich's metaphysics is famously of this kind). Whether we could get away without even that most general kind is unclear; if so there would be bare particulars that would be genuinely bare.

More relevant to a metaphysics appropriate for the actual world, is the question whether kinds are irreducible. I hypothesize, along with David Armstrong (1997: 67-8), that they are not. Richard Boyd (1999) takes biological kinds, such as species, to

[139] Recent debates about the definition of 'planet' suggest that there is no clear kind in question here.

[140] In passing I should mention another feature of Lowe's account of laws. Lowe (2006: 132) takes it as a merit of his account that it shows that laws concern universals—the universals K and F—but does not need to invoke Armstrong's mysterious N. Even so, Lowe needs to answer something like the inference problem. It should be noted that on Lowe's view 'K is F' or 'Ks are F' are to be understood as generic statements (2006: 146) which, like 'birds fly' admit of exceptions in certain cases. So there is no strict inference from 'Ks are F' and '**a** is a K' to '**a** is F.' Nonetheless, generics still imply some important relationship—typical instances of K will very probably be F (and every K will be an F, for a strict law), and Lowe needs to account for this as much as Armstrong (cf. Wasserman 2006). The mere fact that generic statements have this implication is not enough, since the question needing to be answered is why the predication of one universal by another (in a law) is appropriately expressed by English generic statements. Note that one can predicate properties of universals without implying anything about individual instances of the universal: to use an example mentioned by Lowe (2006: 146) 'elephants are numerous in Africa' tells us nothing about any individual elephant, not even that a typical elephant is likely to be living in the Africa. So we are still owed an explanation of how Lowe's ontology of laws has implications for *any* of their instances. Lowe denies that 'elephants are numerous in Africa' is about the kind *elephant* at all. His reason is that the predicate is one which cannot apply to the kind's instances. But that is unconvincing. Consider the statement 'elephants are a large and numerous African herbivore'. This is conjunctive predication involving a component that does apply to individual elephants ('large') and a component that does not ('numerous'); since the former is a predication of the kind, so is the latter.

be *homeostatic property clusters*. The idea is that certain sets of properties tend to group themselves together. Consider all the biological properties that there are: some combinations are found together in the same particular on many occasions whereas other combinations are found together rarely or never at all. The logical space of property combinations is not equally densely occupied by particulars. Some regions are highly populated whereas others are empty. A feature of biological entities is that no two share exactly the same properties, so no point in logical space is occupied by more than one entity. But two conspecifics (members of the same species) share many properties, even if there is no set of properties shared by all conspecifics but not by any non-member of the species. Thus logical space looks a bit like a volume of air with several swarms of bees. No point is occupied by two bees, nor is there a (non-gerrymandered) region occupied by all and only the bees from one swarm—the boundaries between swarms are vague. Nonetheless there are clearly areas of high density of bees, the centres of each swarm and other regions where there are no bees at all. Nor is it an accident that this is the case, that bees tend to swarm. Analogously it is no accident that biological individuals tend to cluster in logical space. To begin with, the laws of inheritance ensure offspring tend to be genetically similar to their parents (in some cases almost identical). Thus related individuals are likely to be similar to one another, and conspecifics will be significantly more similar than non-conspecifics. Mutation is a source of difference, but even individuals with mutated genes will not be hugely different from their parents. The laws of morphology dictate that highly divergent mutants are unlikely to be viable. Most points in the logical space of combinations of biological properties cannot be occupied because any individual attempting to occupy them cannot survive. Furthermore morphologically viable individuals that vary significantly from their parents and other conspecifics are unlikely to be ecologically viable. Natural selection ensures that most members of a population are well fitted to their environment; the more an individual varies from the mean, the less likely it is to breed successfully, and so an outlying neighbourhood in logical space is unlikely to be represented in the next generation.

Thus it is the laws of biology and biological causes that explain the clustering of properties. The existence of biological kinds has a natural explanation, ultimately in terms of laws. The same may well be true of natural kinds in general. When it comes to physical and chemical kinds, the laws may ensure that the clustering of properties is much more sharply defined. First, distinct individuals may share the same precise point in logical space. Two atoms can be identical. Secondly, distinct regions in logical space do exist. Thus while the mass of atoms can vary in such a way that the ranges of masses do overlap, the distinctness of regions is ensured by the fact that nuclear charge keeps the elements apart. So no gerrymandering of logical space is required to draw precise boundaries between elementary and many other chemical kinds. When it comes to more fundamental physical kinds the clustering is better defined still, since all members of the kind (such as electrons) occupy the same point in logical space. These facts will in each case be explained by the laws of nature. Thus it seems to me to be plausible that Boyd's homeostatic property cluster idea can be extended to all natural kinds. The laws will explain why there are certain clusters;

they will also explain the natures of those clusters—the loose and vague clusters in biology, the partially precise clusters of chemistry and the perfectly precise clusters of particle physics. Boyd introduces his idea in order to provide an alternative to the essentialist view of natural kinds. However, if I am right, the homeostatic property cluster approach can be expanded to include the essentialist view in respect of the kinds to which it applies. The laws of nature will explain why—*necessarily*—there are no members of chemical and microphysical kinds that lack certain properties, why of necessity certain properties cluster togther in a partially or fully precise manner.

10.3 Further work—problems from physics

In Chapter 7 I considered the objection that certain properties seem to be counterexamples to dispositional monism. But I have not yet considered objections to the effect that certain laws appear not to be reflections of dispositional properties and would not be explicable on the dispositional essentialist account of laws given here. I shall briefly review the objections of this kind before going on to sketch the responses I recommend. In some cases I think that further work needs to be done, more often in fundamental physics than in metaphysics, to be sure whether or not there is a serious problem for the view I am presenting.

(i) Some laws involve fundamental constants. One could have a world in which the values of these constants are very slightly different. Presumably such small differences in the values of fundamental constants would not require that the properties related in the law in question are different from this world. So even if we think of the properties in question as dispositions, that dispositionality cannot account for the difference between the law we have and the law we might have had. Hence the dispositional account of laws is not a complete account of the nature of laws. Put simply, the values of fundamental constants are nomic features of the world not accounted for by the dispositional conception.

(ii) Conservation and symmetry laws tell us that interactions are constrained by the requirement of preserving, e.g., mass-energy or momentum. But that constraint does not appear to be the manifestation of a disposition.

(iii) Least-action principles are treated as laws and again are not easily cast as relating the stimulus and manifestation of a disposition. Joel Katzav (2004) argues that the principle of least action (PLA) for a system assumes that given its initial state (i.e., given the essential, intrinsic properties of the system in its initial state) various different evolutions are possible. The PLA provides a rule that selects just one of these. The dispositional essentialist, however, believes that given the initial state of the system, only one evolution is possible, that fixed by the essential dispositional natures of the intrinsic features of the initial state.

(iv) Two properties might be involved in distinct laws in accordance with the dispositional conception. But if there is a third law relating these two properties, then that third law will not be the outcome of the dispositional natures of the properties. This might be exemplified by the relationship between gravitational mass and inertial mass. *Prima facie*, at least, it looks as if we have here two dispositional properties, one whose essence is mutual attraction and the other whose essence is to govern the

relationship between force and acceleration. Neither essence entails the other. Gravitational mass is analogous to charge, except that for charge the force is repulsive. But charge is not related to inertial mass. Nonetheless it is a fact, a law of nature, that inertial mass and gravitational mass are related. Regarding these as distinct properties, we can say that every body possesses the one in perfect proportion to the other. This would be a law not entailed by the essence of any property.

10.3.1 *The problem of fundamental constants*

Here the concern is that the values of fundamental constants are nomic facts that are not explicable on the dispositionalist conception. The force of gravitational attraction between two point masses is proportional to the product of the masses and inversely proportional to the square of their separation. Even if these facts concerning proportionality are reflections of the dispositional nature of gravitational mass, it seems not to be essential to gravitational mass that the gravitational constant, G, which governs this proportionality is equal to $6.673 \times 10^{-11}\text{Nm}^2\text{kg}^{-2}$. If this constant is genuinely fundamental, there seems to be a possible world in which the same property entered into a very similar law, a law that differs from our law in that the constant of proportionality takes the value $6.683 \times 10^{-11}\text{Nm}^2\text{kg}^{-2}$. The key premise here is the assertion that G is indeed a fundamental constant. If the law of gravitation is not fundamental but is derived from deeper laws (as physicists indeed believe) then it could well turn out that the value of G is constrained in a way that we do not yet understand. In which case it might be, for all we know, that the value of G is necessary, despite appearances to the contrary, just as the fact that salt dissolves in water is necessary, despite initial appearances. Furthermore, there is indeed reason to think that this might be the case. The intensity of light from a constant and uniform source falling on a unit area decreases in inverse proportion to the square of the distance from the light source. This law could have been discovered experimentally. One could imagine someone thinking the exponent of the displacement, -2, is a fundamental constant. There might be a very similar possible world in which the light intensity is proportional to $d^{-2.000001}$. However, the fact that the intensity is proportional to exactly d^{-2} is derivable from the law of the conservation of energy. So a world in which the intensity is proportional to $d^{-2.000001}$ is not at all similar to ours; it is one where energy (or mass-energy) is not conserved (and it is not clear to me that such a world is genuinely possible).[141] Newton's law of gravitation is also an inverse square law, and its similarity to the law of luminosity encouraged many to think that it too must be explicable as reflecting some deeper law that would show why the force of gravity is proportional to d^{-2} rather than to $d^{-2.000001}$. Einstein eventually showed that they were right. It is thus an epistemic possibility that scientists will find that G is not a fundamental constant either. Indeed there might not be any fundamental constants. This is exactly what Steven Weinberg (1993: 189-91) speculates will be discovered.

[141] Strictly, dimensional analysis tells us that any exponent of a magnitude with a dimension must be integral. However, the point can be made by rewriting the law of gravitation in dimensionless terms, so that we raise not d by the power 2, but rather d/k where k is some constant with dimensions L^{-1}.

It may at first sight seem strange that the acceptability of a philosophical position concerning the nature of properties and laws should depend on certain scientific discoveries. But on reflection this is not so perverse. We have already discussed how necessary truths may be discoverable only *a posteriori* and it is not unreasonable that some such necessary truths are ones we would classify as metaphysical. Furthermore, the naturalistic tendency of much contemporary philosophy should make it easier to think that the boundary between the physical and the metaphysical is not a sharp one, let alone a sharp one characterised by the difference between what is knowable *a posteriori* and what is knowable *a priori*.

10.3.2 *The problem of conservation and symmetry laws*

Several of our most important laws state that certain quantities are conserved in all interactions: mass-energy, charge, momentum, lepton number, angular momentum, etc. Corresponding to these are laws asserting that the universe displays certain symmetries. It is difficult to see why, for example, when two charged objects interact, it is a manifestation of a dispositional essence that the total charge should remain constant. This, I believe, is an important challenge to the dispositional essentialist. One approach is the following. Bigelow *et al.* (1992) regard such laws as reflections of the essence of the world. They take the world to belong to a kind (and *a fortiori* to be the only actual member of that kind). They also take kind membership to depend on essences and laws to flow from essences. So in this case, the world has an essence, and that essence requires that mass-energy, charge, lepton number, etc. are conserved in all interactions. As we have seen, I hope to do without kinds as fundamental as sources of laws—it is only properties that give rise to laws. However, perhaps there is a property corresponding to the kind, the property of being a world, and this property has as its essence the disposition to conserve energy, etc. in response to any event. In which case the conservation and symmetry laws are reflections of the fact that the world possesses this property. Both this version and the Bigelow *et al.* kinds approach seem to me to be somewhat *ad hoc*. Furthermore, the proposal does not account for the fact that such many quantities are conserved locally as well as globally. For example, mass-enery is conserved in any closed system. The latter suggests that the property we are interested in is the property of being a closed system. Even so, the answer is unconvincing. The property in question is a property of an ensemble, a system, rather than its parts. It seems to be a macro-property that is an implausible candidate for being fundamental.

In any case, there is something mysterious about conservation laws. They seem to require explanation for the reason just given. How does a system know that energy should be conserved? The situation seems similar to the issue of least-action principles, which I discussed briefly in Section 9.2, in that the laws are formulated in a way that is mathematically elegant, yet metaphysically mysterious—and not just from a dispositional essentialist perspective. It is not clear how these could be fundamental laws—they seem to stand in need of a deeper explanation. It may be of course, that we just have to accept the mystery, along with other mysteries of modern physics. There is no reason why the fundamental nature of the universe should be even com-

prehensible, let alone intuitive. Even so, in the least-action case we have alternative formulations that are metaphysically less mysterious. In the conservation case the alternative formulation is a symmetry principle, which seems at first sight no more amenable to a dispositional essentialist treatment.[142] However, symmetry principles are meta-statements about our laws. Thus the conservation of energy corresponds to the fact that our laws do not change over time. Such meta-statements themselves raise questions. Are they genuine laws? And if they are, how should we understand them? On Lewis's account, we can regard them as regularities concerning regularities. But even so, they are not required to systematize the Humean mosaic. According to Armstrong, the second-order N constrains relations between F, G, and other first-order universals. Is there a third-order N* that constrains how N is permitted to relate F and G etc.? Some sense may be made of these ideas. But the dispositional essentialist holds that the laws are necessary. If that is correct there is no room for further constraints. Properties are already constrained by their own essences and so there is neither need nor opportunity for higher-order properties to direct which relations they can engage in. The dispositional essentialist ought to regard symmetry principles as pseudo-laws. This proposal is not implausible given other dispositional essentialist commitments. For example, a fundamental symmetry is an invariance, such as the time invariance of the laws already mentioned. Invariances are background features—they decree that certain features remain unchanged while others do. Thus invariant structures are background structures. And we have already seen (Section 7.3) that a desirable feature of physical theories is that they should eliminate background structures. So it may be that symmetry principles and conservation laws will be eliminated as being features of our form of representation rather than features of the world requiring to be accommodated within our metaphysics.

10.3.3 *The problem of least-action principles*

Here it looks as if the existence of a least-action principle implies that a multiplicity of evolutions for a system are possible, given only the intrinsic features of its initial state (absent the PLA itself), whereas dispositional essentialism requires that just one be possible (in a deterministic system). The least-action principle seems to govern the system and its evolution rather than flow from the essential character of its intrinsic properties. The response to this problem is to question the sense in which the PLA for a system implies that, were it not for the PLA, many evolutions are possible. It is natural to say that the PLA chooses one path from many possible paths. But the mathematics of the PLA do nothing to show that such paths are metaphysically possible. The sense of 'possible' is a mathematical/logical one. All that is required is that no contradiction is deducible from the claim that the system's evolution takes a path other than the actual one. The point can be put epistemically. It might be that the intrinsic properties of the initial state make only one evolution possible, thanks to the dispositional essences of those properties. However, in the absence of full knowledge of those essences we may not know which path that is. A PLA is an *a posteriori* tool

[142] There is a connection here to least-action principles, in that Noether's theorem shows the equivalence between conservation laws and symmetry principles holds for systems that obey a least-action principle.

for providing the answer. That is consistent with the PLA itself being necessary, with the actual path being necessary, and with those necessities flowing from the (in this case, unknown) essences of the intrinsic properties of the initial state of the system.

10.3.4 *The problem of mass*

In classical physics mass is (i) a fundamental property, and (ii) associated with two dispositions, one inertial and one gravitational. The latter makes classical mass a multi-track disposition, i.e., a disposition that relates multiplicity of stimuli and manifestations. Indeed, in the terminology of Section 2.2.1 it is an impure disposition, on which does not fit the schema: D is the disposition to manifest ($M_1 \vee M_2 \vee M_3 \vee \ldots$) in response to stimulus ($S_1 \vee S_2 \vee S_3 \vee \ldots$). There I argued that impure dispositions cannot be fundamental. It seems odd that a fundamental property should both yield manifestation M_1 in response to stimulus S_1 and also manifestation M_2 in response to stimulus S_2. That looks like a conjunction of propositions, which does not confirm to the schema, and does not seem fundamental at all. It would appear that such a property, if genuinely a single property, would be a non-fundamental property. There ought to be an explanation of why these stimulus/manifestation combinations occur together. It might be thought that we can split the property into two: one which is the disposition to yield M_1 in response to S_1 and another which is the disposition to yield M_2 in response to S_2. In effect this would be saying that there are two properties, inertial mass and gravitational mass. While there is nothing wrong with this *per se*, it does not do much to help solve our problem. For if we split mass into two properties, inertial mass and gravitational mass, then we must add a new (fundamental) law that these are always and everywhere proportional to one another. This law would be a non-dispositional, contingent law, undermining the claim of dispositionalists to give a full account of the laws of nature.

I do not yet have a clear view of how to answer this problem. A starting point is this. We abandon the conception of mass employed in classical physics. As mentioned in Section 7.3.3 dispositional monism is much better suited to the conception of mass presented by General Relativity. As mentioned in Section 7.3.3 mass and spacetime form a reciprocal dispositional pair—each spacetime point is characterized by its dynamic properties, i.e., its disposition to affect the kinetic properties of an object at that point, captured in the gravitational field tensor at that point. The mass of each object is its disposition to change the curvature of spacetime, that is to change the dynamic properties of each spacetime point. That said, Einstein's equivalence principle is only of limited assistance to the dispositionalist, for inertial and gravitational mass come apart, in effect, in non-gravitational fields. Whether physics presents an irresolvable problem for dispositionalism or indeed a resolution of its problems must await further investigation.

10.4 Final comments

David Lewis remarked that rarely in philosophy does one win with a knockout blow to an opposing view; normally one can only hope to be ahead on points. I am not an impartial observer. Nonetheless, I shall explain how I think the points stack up. Let

us start with properties. In the Preface I explained why I found a picture of properties as divorced in their essence from what they do as deeply unattractive. It permits worlds like ours as regards the possession of properties by things, but without any laws. That I find unintuitive. However, mere intuitive preference does not count for much when others have differing intuitions. The problems for the categoricalist view of properties begin to tell against that view when we come to consider its quidditistic aspect. Quiddities (i.e. categorical properties) lead to problems when we consider the swapping of properties and when we consider the possible duplication of properties. The latter leads to a certain kind of scepticism that is unappealing. One might consider that the former does too, as does Lewis, but I agree with Schaffer that the case is overstated. Rather it is again a matter of intuitive appeal. If you really think there is no problem at all with the idea of swapping charge and inertial mass to produce a genuinely distinct world, then categoricalism's endorsement of quidditism will not count against it on that count. I believe that the scepticism born of the duplication of properties is more problematic and is not so easily dealt with. But the matter will bear further investigation.

So quidditism may count for a few points against the categoricalist view of properties. What counts in its favour? I'm not sure that anything does. Often a view is preferred for being less problematic than its alternative. And so we should turn to potencies. Here there are some advantages. First, it provides a natural criterion for the (transworld) identity of properties. Secondly, it generates an account of the laws of nature. Categoricalism on its own tells us nothing about the laws of nature. I shall come back to the laws of nature shortly. Despite its advantages, dispositional essentialism has not been popular. Some of its disadvantages accrue to *any* view that allows even *one* potency. The alleged disadvantages are those of implying a kind of fundamental intentionality and making the nature of the property imply and depend upon entities that may not exist. The first of these disadvantages is simply an ill-founded accusation (although made plausible by its welcoming acceptance by some dispositional essentialists). Dispositional essentialism loses no points there. The second accusation, of crypto-Meinongianism, has more going for it. But if any points are to be lost here, an equal number must be lost by the categoricalist, at least of the Armstrong variety. Because any view that isn't either a revisionary, Megarian version of actualism that rejects non-trivial dispositional and counterfactual truths, or modal realist, must have the same consequence. The easy way to see this is that potencies are akin to a coagulation of a categorical property and a law. What the former does, the latter combination does too. So if potencies point to their non-existent manifestations, then law-and-categorical-property combinations point to non-existent counterfactual consequences. Of course, if you are a Megarian actualist or a modal realist, then you have already clocked up lots of points against yourself.

Other criticisms against potencies are directed not so much against potencies in themselves but rather against the dispositional monist view that all (fundamental) properties are potencies. The most common criticism is the regress problem. The very point of dispositional essentialism is to provide properties with a criterion of identity. But, so the regress objection goes, it fails to do so if all properties are poten-

cies, since one property's identity is given by its relation to another, and that one's identity is given by its relation to a different property, and so on. Regress and circularity objections are much loved by philosophers and so tend to score many points against a view when they hit the target on the nose. And this one has been thought to do so, even though no philosopher has actually identified the moment of contact. As it happens the graph-theoretic argument shows the objection to miss by a wide mark. It is true that the response implies that properties must be related in asymmetric networks. Is that implausible? I don't think we should expect intuition to have much of a hold here. Rather we should see this as an interesting philosophical discovery. The other objection to dispositional monism was that some properties, for example spatial displacement, cannot be understood as having a dispositional essence. Here the answer was to appeal to developments in physics which change our view of such properties. How strong an answer is that? Well, if the physics does indeed tend in the direction I indicate, then it is as good an answer as one might hope for. It is up to physics to tell us what fundamental properties are like, not our intuitions. That said, the developments I point to are debated and still somewhat speculative (they are preferred by loop quantum gravity theorists, less so by string theorists). The case is similar for some of my responses to the other problems raised by physics earlier in this chapter. For example, the elimination of all constants from fundamental physics looks to be a promising option, but is far from being delivered. Is the dependency of my view on what the physicists may discover a disadvantage? Not in itself. A good scientific metaphysics should be sensitive to developments in science. A metaphysics that was neither supported not threatened by different possible outcomes in physics would be altogether too far removed from physics to be of interest.

I should note at this point that the mixed view, which allows both potencies and categorical properties, has some *prima facie* advantages over dispositional monism. It is not obliged to answer the regress problem, since the categorical properties bring the regress to a halt. It can say that spatial and other structural properties are categorical while allowing other properties to be essentially dispositional. It would thus seem to gain the benefits of the dispositional essentialist account of laws, without the disadvantages. However, the last paragraph suggests that the disadvantages in question are overstated. The regress problem is not a problem and the scientific jury is still out on structural properties. On the other hand, the mixed view, by allowing any categorical properties at all, has to face the problems associated with quidditism. Correspondingly, it cannot appeal to dispositional essence as *the* criterion of property identity. And the very fact that it admits two categories of fundamental property is a point on the debit side. So while the mixed view has been the preferred option for dispositional essentialists, I do not think it is ahead of dispositional monism by many points, if any. Certainly, its advantages are not such that dispositional essentialists can afford to ignore dispositional monism.

A comparative assessment of the views on offer as regards their accounts of properties depends on an assessment of quidditism. If you consider the arguments against quidditism to raise serious problems, dispositional monism ought to be ahead for you. If not, then categorical monism, the mixed view, and dispositional monism are

probably not too far apart on points. The mixed view and dispositional monism do gain more significantly over categorical monism when it comes to the natural laws. Dispositional essentialism generates an account of laws; categoricalism does not. That is already a gain for the former. Furthermore the accounts of law that do accommodate categoricalism are unattractive. The regularity view is such a thin view of laws that according to Mumford it scarcely counts as a view of laws at all. No regularity can govern or explain its instances. Carroll's argument shows how Humean supervenience is deeply implausible. Armstrong's account doesn't suffer from these disadvantages. But like Lewis's regularity view it has also been subject to significant criticisms. One of these is the allegation that Armstrong cannot simultaneously solve the identification and the inference problems. I show that Armstrong cannot solve the inference problem in a manner that is consistent with categoricalism. Consequently that option for adding a view of laws to categoricalism is closed.

Thus both categoricalist options for laws are seriously flawed. Does the dispositional essentialist view suffer from flaws of its own? The main alleged flaw is that it makes the laws of nature necessary and consequently violates both Hume's Dictum and the intuition that laws are contingent. But these are intuitions we should simply reject as explicably being unreliable. At the same time the dispositional essentialist account explains what sort of necessity it is that we also intuit in laws identifying it with the metaphysical necessity we have need of in any case. So dispositional essentialism has the advantage of explaining the laws of nature and explaining their necessity without adding a second kind of necessity.[143] Thus when it comes to laws, dispositional essentialism, i.e. the disjunction of the mixed view and dispositional monism, comes out well ahead on points. That said, this view does depend on the deliverances of physics coming out favourably as regards laws that do not, *prima facie*, look amenable to the dispositional essentialist treatment.

In short, as things currently stand, I am inclined to think that categorical monism is well behind its rivals. There are probably some potencies among the fundamental properties. Are they all potencies? Your answer should depend principally on your take on quidditism. If you think quidditism is flawed, you should adopt dispositional monism. If you think that quidditism is sound, then your decision between the mixed view and dispositional monism may depend on how well you think monism handles structural properties. In any case, there is much further argument to be undertaken, some of it depending on the outcome of advances in physics. I look forward with interest to see how things will develop, confident that dispositional monism is a serious contender.

[143] This opens up the possibility of a dispositional account of modality. Note that $\Box p \equiv \neg p \Box\!\!\rightarrow p$. So if (CA) were true, we could use this equivalence to provide a dispositional analysis of necessity; details await development.

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